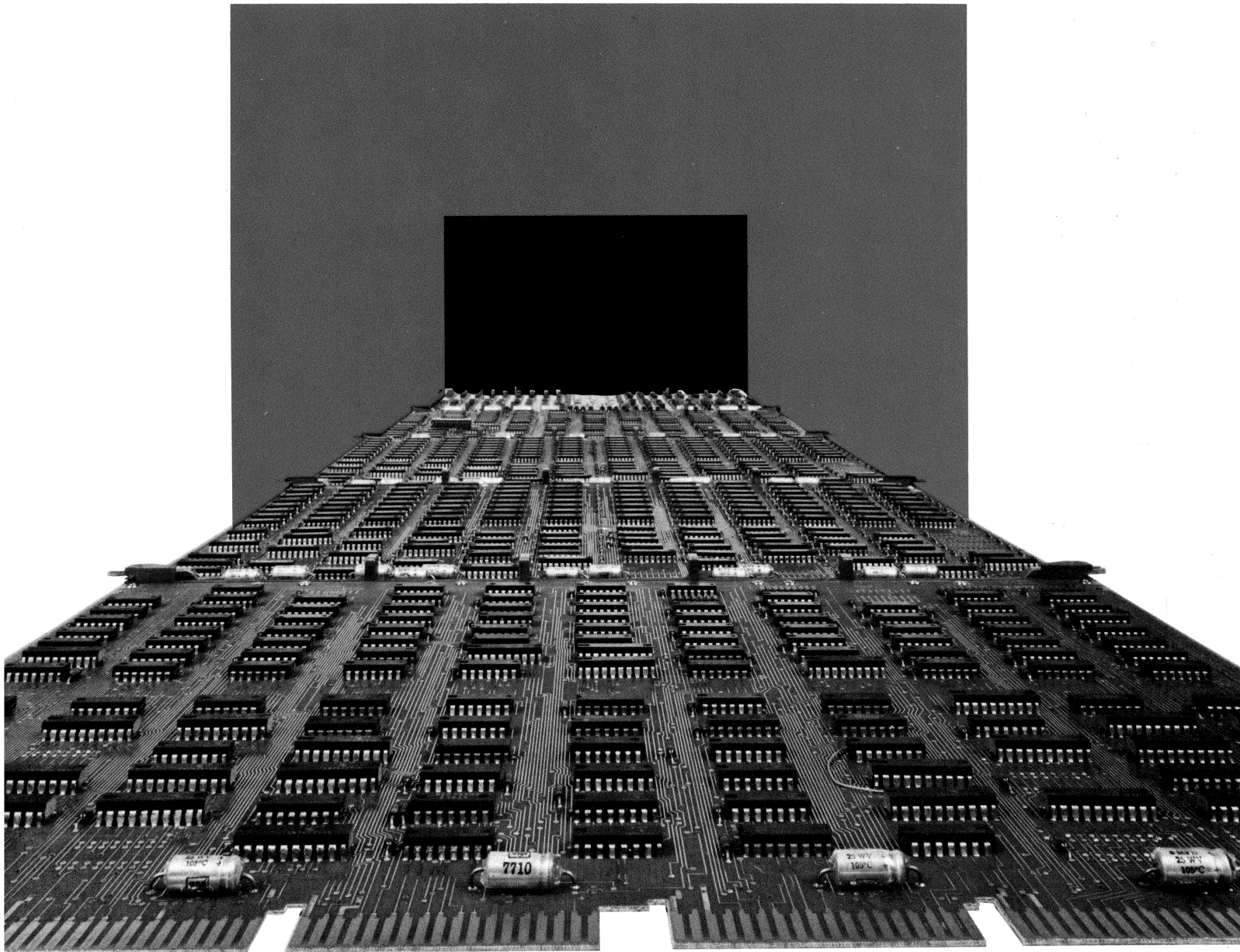


VAX-11/780

Processor Internals

Supplementary Diagrams and Listings



digital

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VAX-11/780

Processor Internals

Supplementary Diagrams and Listings

COURSE NUMBER
EY-C5114-LE-001
(J6024-A)

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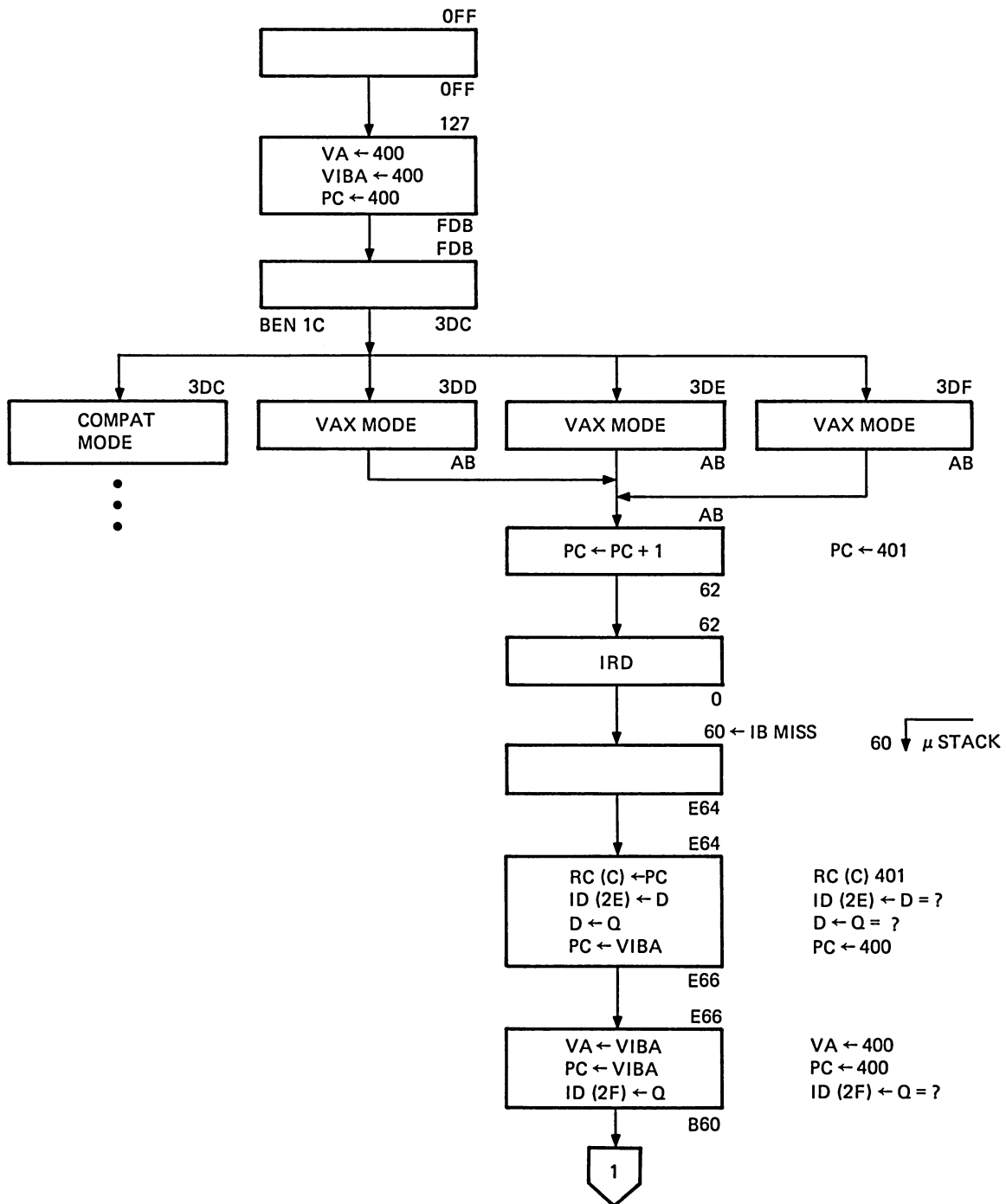
LISTINGS 14

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INTRODUCTION

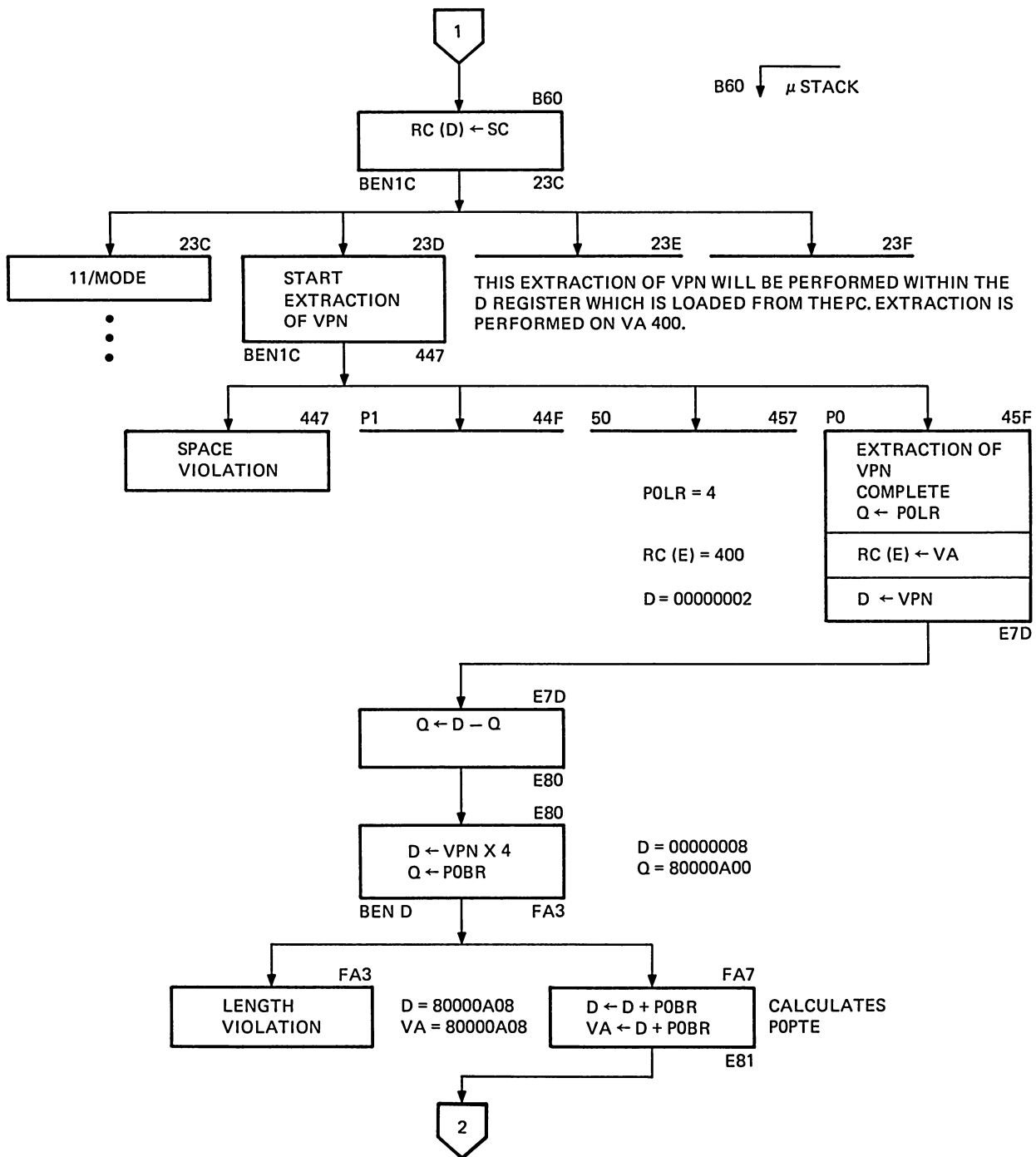
Students taking the VAX-11/780 Processor Internals course will need to refer to this booklet while studying the 11/780 Internal Operations module. This reference presents, in summary form, the data needed to analyze the program being studied.

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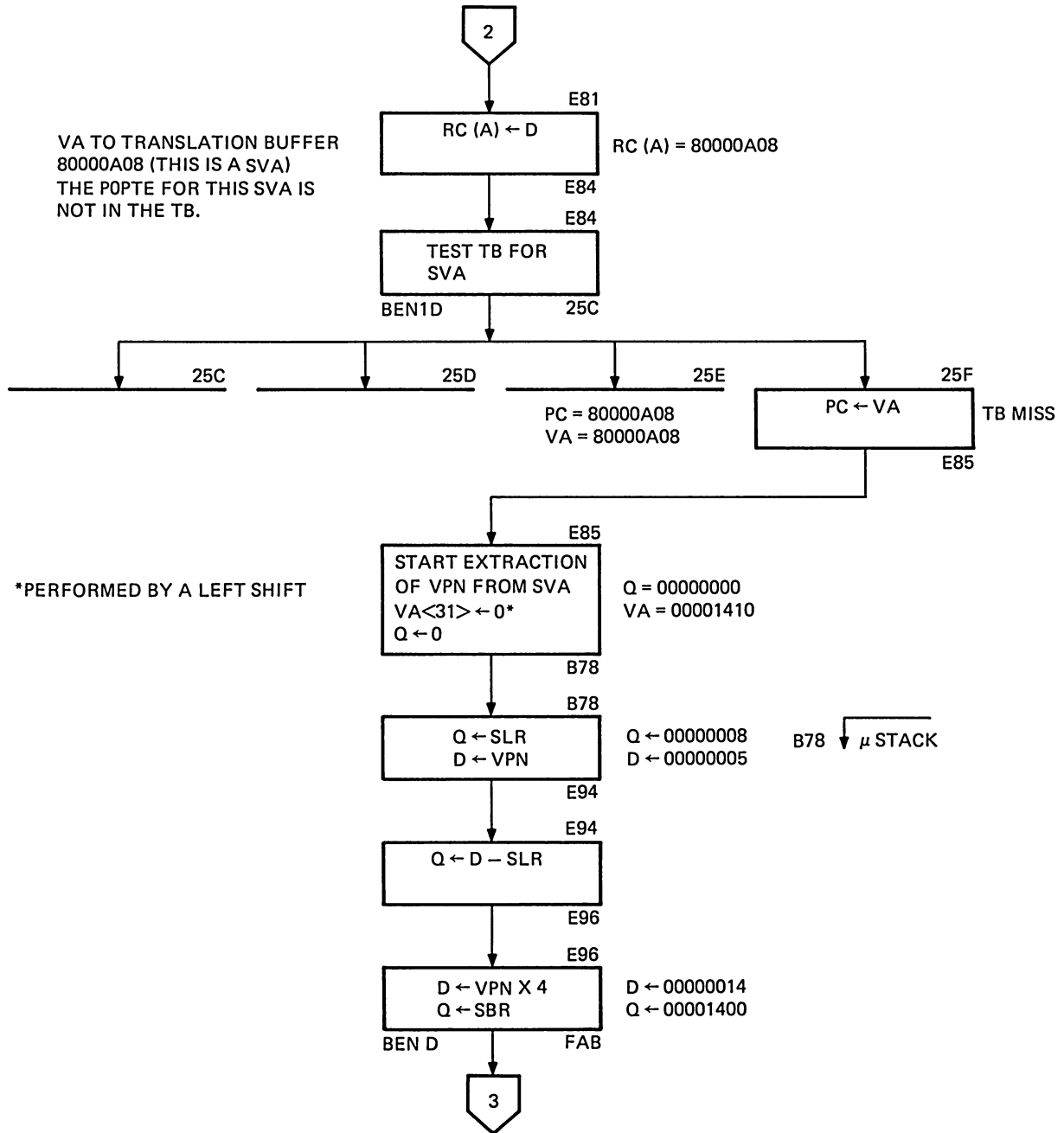


TK-4343

Translation Flow Diagram (Sheet 1 of 5)

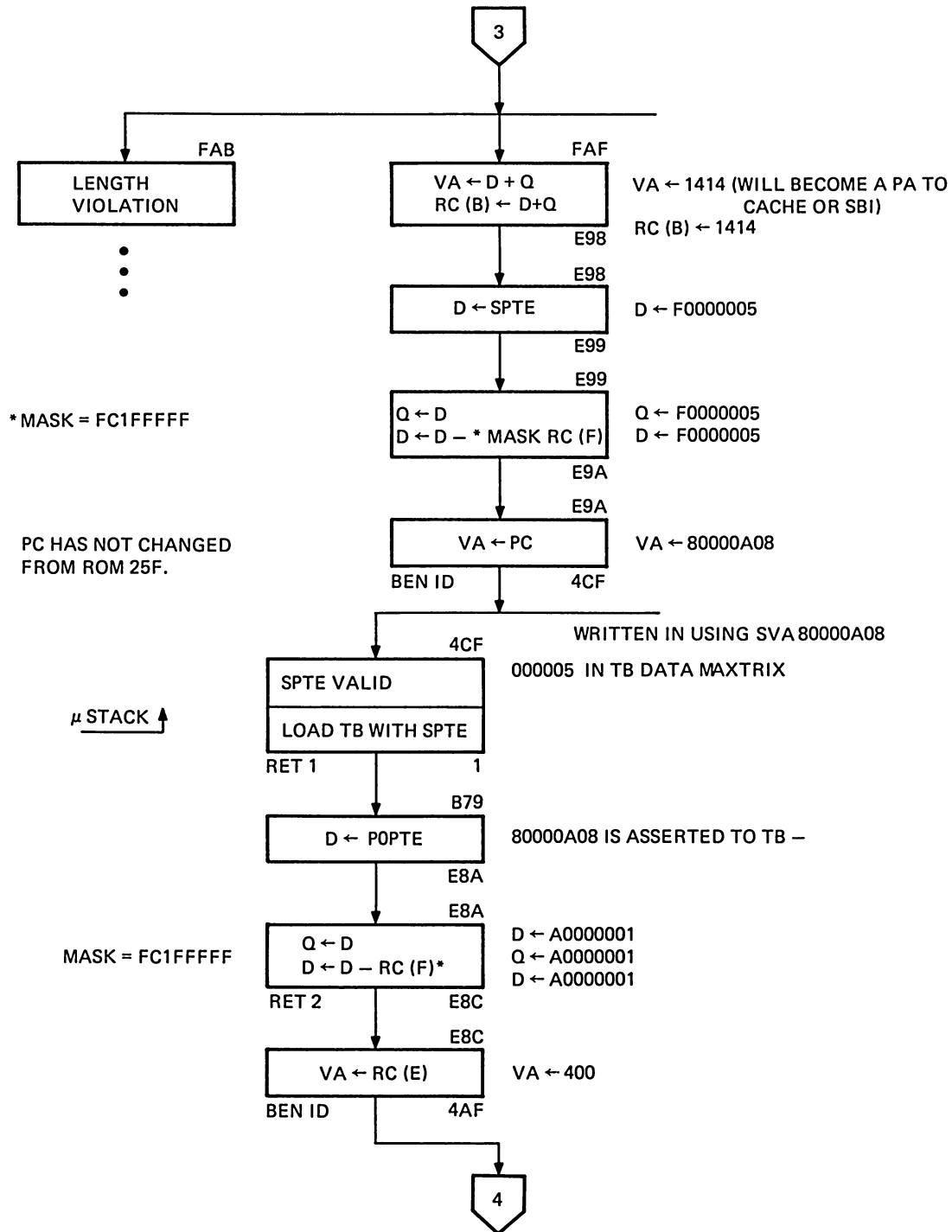


TK-4344



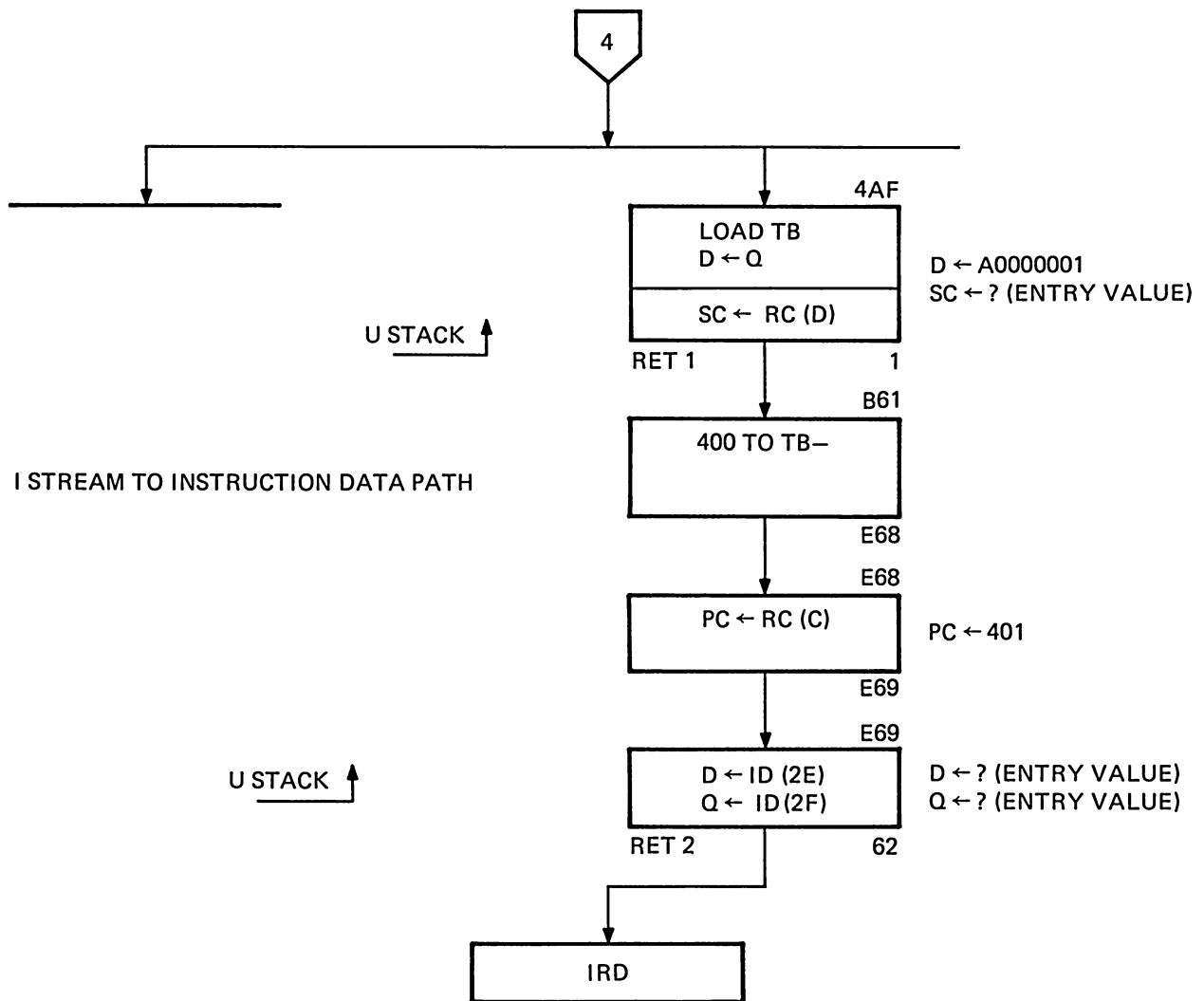
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Translation Flow Diagram (Sheet 3 of 5)



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Translation Flow Diagram (Sheet 4 of 5)



TRANSLATION FLOW

TK-4347

Translation Flow Diagram (Sheet 5 of 5)

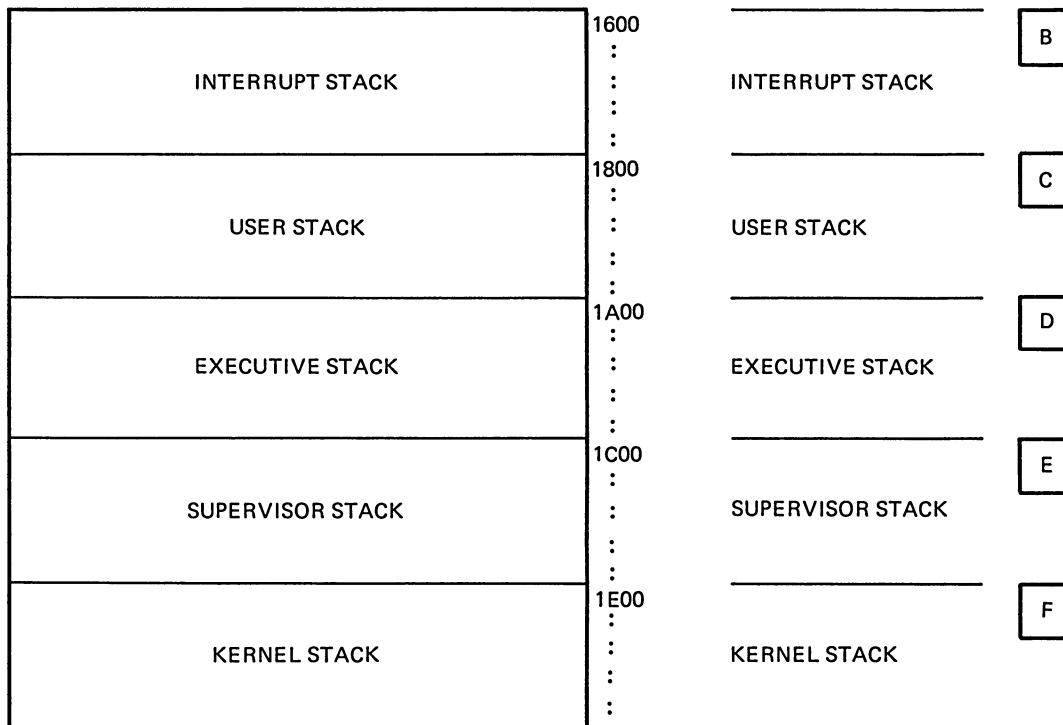
00000003		0		PFN
00000003		4		0
:		:		
:		:		
80000100	! ACCESS VIOLATION	20	SYSTEM CONTROL	
80000000	! PAGEFAULT (XLATION NOT V)	24	BLOCK	
00000003		28		
:		:		
:		:		
90528190	! MOVB (R1)+, R2	200		1
52815483	! MOVB (R3)+, R4	204		
00005554	! ADDB3 R2, R4, R5	208		
	! HALT	:		
		:	P0 SPACE PROGRAM	
90528190	!	300	(PROGRAM REGION)	
52815483	! SAME CODE AS ABOVE	304		
00005554	!	308		
		:		
		:		
0000000A	! FIRST P0 OPERAND	400		2
		:	P0 OPERAND	
		:		
		600		3
		:	OPEN – NOT IN USE	
		:		
885857D0	! MOVL R7, R8	800		4
03AA808F	! BISB # X80, 3(R10)	804	CODE TO HANDLE	
025E08C0	! CLEAN UP STACK	808	THE PAGEFAULTS	
	! REI		(TRANSLATION NOT	
		:	VALID FAULT)	
		:		
00000206	! LDPCTX	850	CONTEXT SWITCHER	
	! REI	:		
		:		
		:		
D05E08C0	! CLEAN UP STACK	900	CONTEXT SWITCHER &	
50DA5957	! MOVL R7, R9	904	ACCESS CONTROL	
8F880710	! MTPR R0, \$PR\$_PCBB	908	VIOLATION EXCEPTION	
DA03AAA0	! SVPCTX	90C	HANDLER	
02061050	! BISB # XA0, 3(R10)	:		
	! MTPR R0, # PR\$_PCBB	:		
	! LDPCTX	:		
	! REI	:		
		:		
		:		
00000000	! POPTE FOR NO ACCESS PAGE	A00		5
A0000002	! POPTE FOR FIRST P0 OPERAND	A04		
A0000001	! POPTE FOR PROGRAM	A08	POPT	
A0000006	! POPTE FOR SECOND OPERAND	A0C	(P0 PAGE TABLE)	
		:		
		:		

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Physical Address Layout (Sheet 1 of 3)

0000000B	! SECOND P0 OPERAND	C00			6
		:	P0 OPERAND		
		:			
A000000C	! P1PTE FOR USER STACK	E00			7
00000000	! P1PTE FOR NO ACCESS PAGE	E04			
F000000F	! P1PTE FOR KERNEL STACK	E08			
E800000D	! P1PTE FOR EXECUTIVE STACK	E0C	P1PT		
E000000E	! P1PTE FOR SUPERVISOR STACK	E10	(P1 PAGE TABLE)		
00000000	! P1PTE FOR NO ACCESS PAGE	E14			
		:			
		:			
		1000			8
		:	OLD PCB STORAGE		
		:			
7FFFA00	! KSP	1200			9
7FFFC00	! ESP	1204			
7FFFFE00	! SSP	1208			
7FFFF600	! USP	120C			
00001100	! R0	1210			
00000200	! R1	1214			
00000000	! R2	1218			
00000600	! R3	121C			
00000000	! R4	1220			
00000000	! R5	1224			
00001200	! R6	1228			
12345678	! R7	122C	NEW PCB		
00000000	! R8	1230	(PROCESS CONTROL		
00000000	! R9	1234	BLOCK)		
80000A08	! R10	1238			
00000000	! R11	123C			
00000000	! R12 (AP)	1240			
00000000	! R13 (FP)	1244			
00000400	! R15 (PC)	1248			
00000000	! PSL (KERNEL MODE)	124C			
80000A00	! P0BR	1250			
04000004	! ASTLVL, P0LR	1254			
7F800C18	! P1BR	1258			
001FFFA	! P1LR	125C			
		:			
		:			
F0000004	! SPTE FOR SYSTEM CODE	1400			A
F000000B	! SPTE FOR INTERRUPT STACK	1404			
F0000000	! SPTE FOR SCB	1408			
F0000008	! SPTE FOR OLD PCB	140C			
F0000009	! SPTE FOR NEW PCB	1410	SPT		
F0000005	! SPTE FOR P0PT	1414	(SYSTEM PAGE TABLE)		
F0000007	! SPTE FOR P1PT	1418			
F000000A	! SPTE FOR SPT	141C			
		:			
		:			

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REGISTER INITIALIZATION VALUES –

IPR	NAME	VALUE
4	ISP	80000400
C	SBR	1400
D	SLR	8
10	PCBB	1200
11	SCBB	0
38	MME	1
39	TBIA	0

OTHERS

R0	R0	0
R1	R1	0
R2	R2	0
R3	R3	0
R4	R4	0
R5	R5	0
R6	R6	0
R7	R7	0
R8	R8	0
R14	SP	80000400
ID F	PSL	04000000

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P0 SPACE (PROGRAM REGION)	NO ACCESS PAGE	00000000
	OPERAND #1	00000200
	P0 MAIN PROGRAM	00000400
	OPERAND #2	00000600
	⋮	00000800
	NOT MAPPED	3FFFFFFF
P1 SPACE (CONTROL REGION)	⋮	40000000
	NOT MAPPED	7FFFF3FF
	⋮	7FFFF400
	USER STACK	7FFFF600
	NO ACCESS PAGE	7FFFF800
	KERNEL STACK	7FFFFA00
	EXECUTIVE STACK	7FFFFC00
	SUPERVISOR STACK	7FFFFE00
S0 SPACE (SYSTEM SPACE)	NO ACCESS PAGE	80000000
	PAGE FAULT & SYSTEM CODE	80000200
	INTERRUPT STACK	80000400
	SCB (SYSTEM CONTROL BLOCK)	80000600
	OLD PCB STORAGE	80000800
	NEW PCB (PROCESS CONTROL BLOCK)	80000A00
	POPT (P0 PAGE TABLE)	80000C00
	P1PT (P1 PAGE TABLE)	80000E00
	SPT (SYSTEM PAGE TABLE)	80001000
	NOT MAPPED	⋮

TK-4333

Virtual Address Layout

TRANSLATION BUFFER

	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
VA400	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0

WILL CREATE A TB MISS 1ST GO AROUND –
AN SVA ADDRESS IS GENERATED

	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
SVA	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0

μSTATE
FA7

PRESENTED TO TB

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00	
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	0	0

μSTATE

E84

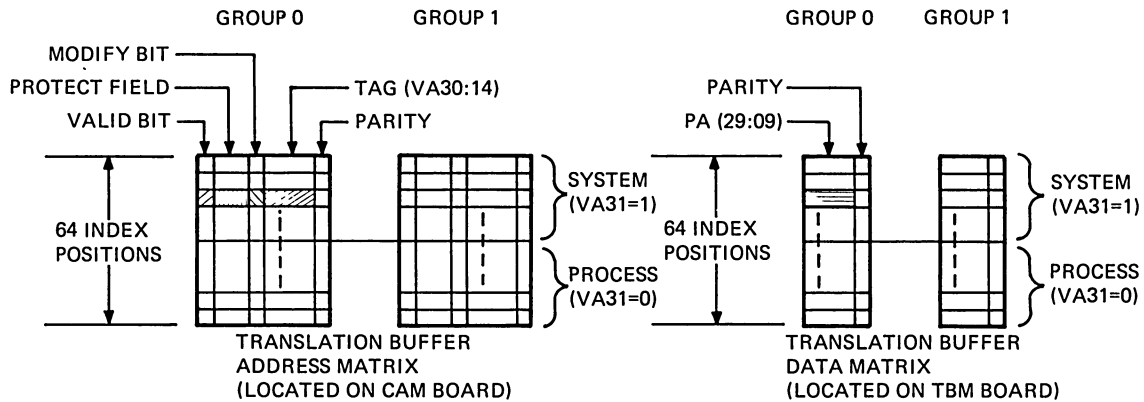
μSTATE
E84

TAG=0 INDEX=25

SPTE FETCHED FROM ADDRESS 1414. THIS WILL BE WRITTEN INTO TB.

	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1

μSTATE
E98



GROUPS ARE SELECTED AT RANDOM TO WRITE INTO.

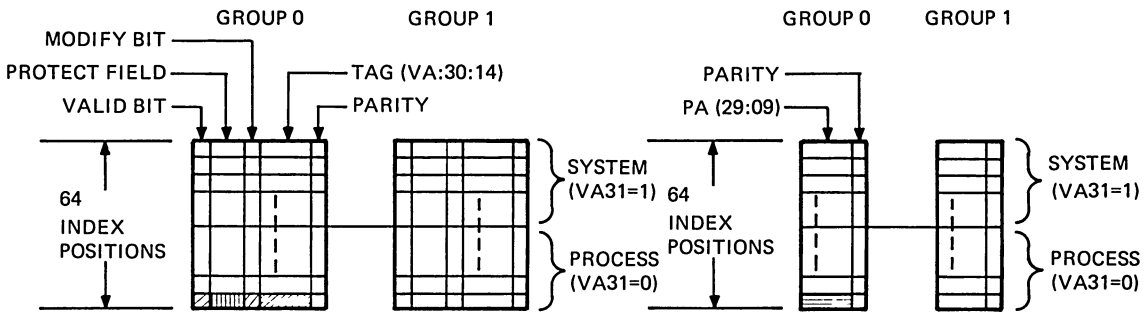
SPTE WILL GENERATE THE PA FOR POPTE WHICH IS FETCHED AND WRITTEN INTO TB.

	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

μSTATE
4AF

THIS WILL BE WRITTEN INTO TB USING SVA 400
INDEX 2
TAG 0

TK-4452



WHEN VA 404 IS ASSERTED

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	

INDEX=LOCATION 2

TAG OF VA=TAG IN LOCATION 2

HIT

PFN FROM TB=PA(29:9)

20	19	18	17	16	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

CONCATENATED WITH BITS (8:0) OF SVA

08	07	06	05	04	03	02	01	00
0	0	0	0	0	0	1	0	0

CREATES A PA OF 204
THIS GOES TO CACHE

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
PA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0

512 LOCATIONS

TAG (29:12)
DUAL INDEX
INDEX (11:3)
SELECTS LOCATION
IN BOTH GROUPS OF
ADDRESS AND DATA
MATRIX

INDEX=40
TAG=0

INDEX
(11:3) AND (2)
SELECTS DATA LONG WORD
OF THE INDEXED LOCATION
OF DATA MATRIX.

NOTE:

ADDRESS 200	ADDRESS 204
TAG=0	TAG=0
INDEX=40	INDEX=40
BIT2=0 LOW WORD	BIT2=1 HIGH WORD

TK-4453

Translation Buffer (Sheet 2 of 2)

127

UWORD IN HEX = 20140E380180F80042000FDB UWORD ADDRESS = 0127

KEY / 9999998888888888777777777766666666655555555544444444433333333322222222211111111110000000000
 \ 54321098765432109876543210987654321098765432109876543210987654321098765432109876543210

BINARY = 00100000000101000000111000111000000000110000000111110000000000010000100000000000011111011011

ACF = 0	NOOP	IEK = 1	ISTR
ACM = 3	TBS	JMP = FDB	
ADS = 1	PHYSICAL	KMX = 0	8
ALU = E	B	MCT = 1F	ALLOW.IB.READ
AMX = 0	LA	MSC = 0	NOOP
BEN = E	INTERRUPT	QK = 0	NOOP
BMX = 5	PC	PCK = 0	NOOP
CCK = 0	NOOP	RMX = 0	RAMX_D RBMX_Q
CID = 7	ID REG_ID BUS-ID ADR=KMX	SCK = 0	NOOP
DK = 0	NOOP	SGN = 0	NOOP
DT = 0	LONG	SHF = 0	ALU
EALU = 0	A	SI = 3	0 D_0 Q_0
EBMX = 0	FE	SMX = 0	EALU
FEK = 0	NOOP	SPO = 0	NOOP
FS = 0	ENABLE MCT	SUB = 0	NOOP
IBC = 2	FLUSH, LOAD VIBA	VAK = 1	LOAD VA

FDB

UWORD IN HEX = 30001C3C01801C00000003DC UWORD ADDRESS = 0FDB

KEY / 9999998888888888777777777766666666655555555544444444433333333322222222211111111110000000000
 \ 54321098765432109876543210987654321098765432109876543210987654321098765432109876543210

BINARY = 00110000000000000001110000111100000000110000000001110000000000000000000000000000001111011100

ACF = 0	NOOP	IEK = 0	NOOP
ACM = 3	TBS	JMP = 3DC	
ADS = 0	VIRTUAL	KMX = 0	8
ALU = F	A	MCT = 3	UNUSED
AMX = 0	LA	MSC = 0	NOOP
BEN = 1C	PSL MODE	QK = 0	NOOP
BMX = 0	MASK	PCK = 0	NOOP
CCK = 0	NOOP	RMX = 0	RAMX_D RBMX_Q
CID = 3	CNSL CONT	SCK = 0	NOOP
DK = 0	NOOP	SGN = 0	NOOP
DT = 0	LONG	SHF = 0	ALU
EALU = 0	A	SI = 3	0 D_0 Q_0
EBMX = 0	FE	SMX = 0	EALU
FEK = 0	NOOP	SPO = 0	NOOP
FS = 1	ENABLE CID	SUB = 0	NOOP
IBC = 3	START	VAK = 0	NOOP

3DF

UWORD IN HEX = 0000003C01801C00000000AB UWORD ADDRESS = 03DF

KEY / 9999998888888888777777777666666666555555555444444443333333322222222111111111000000000
 \ 54321098765432109876543210987654321098765432109876543210987654321098765432109876543210

BINARY = 0000000000000000000000000111100000000011000000000111000000000000000000000000010101011

ACF = 0	NOOP	IEK = 0	NOOP
ACM = 3	TBS	JMP = AB	
ADS = 0	VIRTUAL	KMX = 0	8
ALU = F	A	MCT = 3	UNUSED
AMX = 0	LA	MSC = 0	NOOP
BEN = 0	NOP	QK = 0	NOOP
BMX = 0	MASK	PCK = 0	NOOP
CCK = 0	NOOP	RMX = 0	RAMX_D RBMX_Q
CID = 3	CNSL CONT	SCK = 0	NOOP
DK = 0	NOOP	SGN = 0	NOOP
DT = 0	LONG	SHF = 0	ALU
EALU = 0	A	SI = 3	0 D_0 Q_0
EBMX = 0	FE	SMX = 0	EALU
FEK = 0	NOOP	SPO = 0	NOOP
FS = 1	ENABLE CID	SUB = 0	NOOP
IBC = 0	NOOP	VAK = 0	NOOP

AB

UWORD IN HEX = 0000003C0180600400000062 UWORD ADDRESS = 00AB

KEY / 9999998888888888777777777666666666555555555444444443333333322222222111111111000000000
 \ 54321098765432109876543210987654321098765432109876543210987654321098765432109876543210

BINARY = 000000000000000000000000011110000000001100000000110000000001000000000000000000000001100010

ACF = 0	NOOP	IEK = 0	NOOP
ACM = 3	TBS	JMP = 62	
ADS = 0	VIRTUAL	KMX = 0	8
ALU = F	A	MCT = C	READ.V.NEWPC
AMX = 0	LA	MSC = 0	NOOP
BEN = 0	NOP	QK = 0	NOOP
BMX = 0	MASK	PCK = 4	PC_PC+1
CCK = 0	NOOP	RMX = 0	RAMX_D RBMX_Q
CID = 4	IDBUS_ID REG-ID ADR=SC 5:0	SCK = 0	NOOP
DK = 0	NOOP	SGN = 0	NOOP
DT = 0	LONG	SHF = 0	ALU
EALU = 0	A	SI = 3	0 D_0 Q_0
EBMX = 0	FE	SMX = 0	EALU
FEK = 0	NOOP	SPO = 0	NOOP
FS = 0	ENABLE MCT	SUB = 0	NOOP
IBC = 0	NOOP	VAK = 0	NOOP

62 UWORD IN HEX = F80C003B01F1F857139B6000 UWORD ADDRESS = 0062

```

KEY / 99999988888888887777777776666666665555555554444444443333333332222222221111111110000000000
\ 54321098765432109876543210987654321098765432109876543210987654321098765432109876543210
-----
BINARY = 11111000000011000000000000011101100000001111100011111100001010111000100111001101101101000000000000000

ACF = 0      NOOP                      IEK = 0      NOOP
ACM = 3      TBS                      JMP = 0
ADS = 1      PHYSICAL                 KMX = 0      8
ALU = E      B                       MCT = 1F      ALLOW.IB.READ
AMX = 0      LA                      MSC = 4      IRD STATE
BEN = 0      NOP                     QK = E      LOAD ID BUS
BMX = 3      LB                      PCK = 7      PC_PC+N
CCK = 1      LOAD UBRANCH CC         RMX = 0      RAMX_D RBMX_Q
CID = 7      ID REG_ID BUS-ID ADR=KMX SCK = 1      LOAD SC
DK = 8      LOAD SHF(INT FORM)       SGN = 1      SS_ALU15
DT = 0      LONG                     SHF = 0      ALU
EALU= 3      B                       SI = 3      0 D_0 Q_0
EBMX= 2      AMX EXP                 SMX = 3      ALU EXP
FEK = 1      LOAD FE                 SPO = A      LOAD LA, LB[RA=SP2R, RB=SP1R]
FS = 0      ENABLE MCT              SUB = 3      CALL DPT
IBC = F      CLR B1-B5 COND          VAK = 1      LOAD VA

```

60 UWORD IN HEX = 0000003D0180F80000000E64 UWORD ADDRESS = 0060

```

KEY / 99999988888888887777777776666666665555555554444444443333333332222222221111111110000000000
\ 54321098765432109876543210987654321098765432109876543210987654321098765432109876543210
-----
BINARY = 00000000000000000000000001111010000000110000000111110000000000000000000000000111001100100

ACF = 0      NOOP                      IEK = 0      NOOP
ACM = 3      TBS                      JMP = E64
ADS = 1      PHYSICAL                 KMX = 0      8
ALU = F      A                       MCT = 1F      ALLOW.IB.READ
AMX = 0      LA                      MSC = 0      NOOP
BEN = 0      NOP                     QK = 0      NOOP
BMX = 0      MASK                    PCK = 0      NOOP
CCK = 0      NOOP                    RMX = 0      RAMX_D RBMX_Q
CID = 7      ID REG_ID BUS-ID ADR=KMX SCK = 0      NOOP
DK = 0      NOOP                     SGN = 0      NOOP
DT = 0      LONG                     SHF = 0      ALU
EALU= 0      A                       SI = 3      0 D_0 Q_0
EBMX= 0      FE                      SMX = 0      EALU
FEK = 0      NOOP                    SPO = 0      NOOP
FS = 0      ENABLE MCT              SUB = 1      CALL
IBC = 0      NOOP                    VAK = 0      NOOP

```

E64

UWORD IN HEX = 1C140038B9803DE22C000E66 UWORD ADDRESS = 0E64

KEY / 99999988888888887777777776666666666555555555444444443333333332222222221111111110000000000
 \ 54321098765432109876543210987654321098765432109876543210987654321098765432109876543210

BINARY = 0001110000010100000000000011100010111001100000000011101111000100010110000000000000111001100110

ACF = 0	NOOP	IEK = 0	NOOP
ACM = 3	TBS	JMP = E66	
ADS = 0	VIRTUAL	KMX = 2E	19
ALU = E	B	MCT = 7	LOCKWRITE.V.XCHK
AMX = 0	LA	MSC = B	SET NESTED ERR
BEN = 0	NOP	QK = 0	NOOP
BMX = 5	PC	PCK = 2	PC_VIBA
CCK = 0	NOOP	RMX = 0	RAMX_D RBMX_Q
CID = 7	ID REG_ID BUS-ID ADR=KMX	SCK = 0	NOOP
DK = C	LOAD Q	SGN = 0	NOOP
DT = 0	LONG	SHF = 0	ALU
EALU = 0	A	SI = 3	O D_0 Q_0
EBMX = 0	FE	SMX = 0	EALU
FEK = 0	NOOP	SPO = 3C	WRITE RC TC
FS = 1	ENABLE CID	SUB = 0	NOOP
IBC = 1	STOP	VAK = 0	NOOP

E66

UWORD IN HEX = 00140038BD803C0002000B60 UWORD ADDRESS = 0E66

KEY / 99999988888888887777777776666666666555555555444444443333333332222222221111111110000000000
 \ 54321098765432109876543210987654321098765432109876543210987654321098765432109876543210

BINARY = 000000000001010000000000001110001011110110000000001110000000000000010000000000000101101100000

ACF = 0	NOOP	IEK = 0	NOOP
ACM = 3	TBS	JMP = B60	
ADS = 0	VIRTUAL	KMX = 2F	FFF9
ALU = E	B	MCT = 7	LOCKWRITE.V.XCHK
AMX = 0	LA	MSC = 0	NOOP
BEN = 0	NOP	QK = 0	NOOP
BMX = 5	PC	PCK = 0	NOOP
CCK = 0	NOOP	RMX = 0	RAMX_D RBMX_Q
CID = 7	ID REG_ID BUS-ID ADR=KMX	SCK = 0	NOOP
DK = 0	NOOP	SGN = 0	NOOP
DT = 0	LONG	SHF = 0	ALU
EALU = 0	A	SI = 3	O D_0 Q_0
EBMX = 0	FE	SMX = 0	EALU
FEK = 0	NOOP	SPO = 0	NOOP
FS = 1	ENABLE CID	SUB = 0	NOOP
IBC = 0	NOOP	VAK = 1	LOAD VA

B60

UWORD IN HEX = 00181C391D8009E80000023C UWORD ADDRESS = 0B60

KEY / 999999888888888877777777766666666655555555444444444333333333222222221111111110000000000
 \ 54321098765432109876543210987654321098765432109876543210987654321098765432109876543210

 BINARY = 0000000000011000000111000011100100011101100000000001001111010000000000000000000001000111100

ACF = 0	NOOP	IEK = 0	NOOP
ACM = 3	TBS	JMP = 23C	
ADS = 0	VIRTUAL	KMX = 7	SC(9:0)
ALU = E	B	MCT = 1	MEM.NOP
AMX = 0	LA	MSC = 0	NOOP
BEN = 1C	PSL MODE	QK = 0	NOOP
BMX = 6	KMX	PCK = 0	NOOP
CCK = 0	NOOP	RMX = 0	RAMX_D RBMX_Q
CID = 1	UNUSED	SCK = 0	NOOP
DK = 0	NOOP	SGN = 0	NOOP
DT = 0	LONG	SHF = 0	ALU
EALU = 0	A	SI = 3	0 D_0 Q_0
EBMX = 0	FE	SMX = 0	EALU
FEK = 0	NOOP	SPO = 3D	WRITE RC TD
FS = 0	ENABLE MCT	SUB = 1	CALL
IBC = 0	NOOP	VAK = 0	NOOP

23F

UWORD IN HEX = 08341C38DDF8080000846447 UWORD ADDRESS = 023F

KEY / 999999888888888877777777766666666655555555444444444333333333222222221111111110000000000
 \ 54321098765432109876543210987654321098765432109876543210987654321098765432109876543210

 BINARY = 00001000001101000001110000111000110111011111000000010000000000000000100001000110010001000111

ACF = 0	NOOP	IEK = 0	NOOP
ACM = 3	TBS	JMP = 447	
ADS = 0	VIRTUAL	KMX = 37	FFF6
ALU = E	B	MCT = 1	MEM.NOP
AMX = 0	LA	MSC = 0	NOOP
BEN = 1C	PSL MODE	QK = F	LOAD ZERO
BMX = 5	PC	PCK = 0	NOOP
CCK = 0	NOOP	RMX = 0	RAMX_D RBMX_Q
CID = 1	UNUSED	SCK = 1	LOAD SC
DK = 8	LOAD SHF(INT FORM)	SGN = 0	NOOP
DT = 0	LONG	SHF = 1	ALU[L1]
EALU = 3	B	SI = 3	0 D_0 Q_0
EBMX = 1	KMX(9:0)	SMX = 0	EALU
FEK = 0	NOOP	SPO = 0	NOOP
FS = 0	ENABLE MCT	SUB = 0	NOOP
IBC = 0	NOOP	VAK = 0	NOOP

20

```
KEY / 999999888888888877777777776666666666555555554444444433333333222222221111111110000000000
\ 54321098765432109876543210987654321098765432109876543210987654321098765432109876543210
```

```

ACF = 0      NOOP      IEK = 0      NOOP
ACM = 3      TBS       JMP = FA3
ADS = 0      VIRTUAL   KMX = 24      1F00
ALU = F      A         MCT = 5      WRITE.V.NOCHK
AMX = 0      LA        MSC = 0      NOOP
BEN = D      SIGNS     QK = E      LOAD ID BUS
BMX = 0      MASK      PCK = 0      NOOP
CCK = 0      NOOP      RMX = 0      RMX_D RBMX_0
CID = 5      ID BUS_ID REG-ID ADR=KMX SCK = 0      NOOP
DK = 1       DOUBLE SHIFT LEFT      SGN = 0      NOOP
DT = 0       LONG      SHF = 0      ALU
EALU= 0      A         SI = 3      0 D_0 0_0
EBMX= 0      FE        SMX = 0      EALU
FEK = 0      NOOP      SPO = 0      NOOP
FS = 1       ENABLE CID SUB = 0      NOOP
IBC = 0      NOOP      VAK = 0      NOOP

```

FA7

```
KEY / 999999888888888888887777777777776666666666555555555544444444443333333333222222222211111111110000000000
\ 543210987654321098765432109876543210987654321098765432109876543210987654321098765432109876543210
```

```

ACF = 0      NOOP      IEK = 0      NOOP
ACM = 3      TBS       JMP = E81
ADS = 0      VIRTUAL   KMX = 0      8
ALU = 5      A+B       MCT = 1      MEM.NOP
AMX = 1      RAMX      MSC = F      INH CM
BEN = 0      NOP       QK = 0      NOOP
BMX = 7      RBMX      PCK = 0      NOOP
CCK = 0      NOOP      RMX = 0      RAMX_D RBMX_Q
CID = 1      UNUSED    SCK = 0      NOOP
DK = 8       LOAD SHF(INT FORM)  SGN = 0      NOOP
DT = 0       LONG      SHF = 0      ALU
EALU= 0      A         SI = 3      0 D_0 Q_0
EBMX= 0      FE        SMX = 0     EALU
FEK = 0      NOOP      SPO = 0     NOOP
FS = 0       ENABLE MCT  SUB = 0     NOOP
IBC = 0      NOOP      VAK = 1     LOAD VA

```

E81 UWORD IN HEX = 0001003C018001D03C000E84 UWORD ADDRESS = E81

```

KEY / 99999988888888887777777776666666665555555554444444443333333332222222221111111110000000000
\ 54321098765432109876543210987654321098765432109876543210987654321098765432109876543210
-----
BINARY = 0000000000000001000000000011110000000001100000000000001110100000011110000000000000111010000100

```

ACF = 0	NOOP	IEK = 0	NOOP
ACM = 3	TBS	JMP = E84	
ADS = 0	VIRTUAL	KMX = 0	8
ALU = F	A	MCT = 0	TEST.RCHK
AMX = 1	RAMX	MSC = F	INH CM
BEN = 0	NOOP	QK = 0	NOOP
BMX = 0	MASK	PCK = 0	NOOP
CCK = 0	NOOP	RMX = 0	RAMX_D RBMX_Q
CID = 0	NOOP	SCK = 0	NOOP
DK = 0	NOOP	SGN = 0	NOOP
DT = 0	LONG	SHF = 0	ALU
EALU = 0	A	SI = 3	0 D_0 Q_0
EBMX = 0	FE	SMX = 0	EALU
FEK = 0	NOOP	SPO = 3A	WRITE RC TA
FS = 0	ENABLE MCT	SUB = 0	NOOP
IBC = 0	NOOP	VAK = 0	NOOP

E84 UWORD IN HEX = 00001D3C018008003C00025C UWORD ADDRESS = E84

```

KEY / 99999988888888887777777776666666665555555554444444443333333332222222221111111110000000000
\ 54321098765432109876543210987654321098765432109876543210987654321098765432109876543210
-----
BINARY = 00000000000000000011101001111000000000110000000000100000000000001111000000000000001001011100

```

ACF = 0	NOOP	IEK = 0	NOOP
ACM = 3	TBS	JMP = 25C	
ADS = 0	VIRTUAL	KMX = 0	8
ALU = F	A	MCT = 1	MEM.NOP
AMX = 0	LA	MSC = F	INH CM
BEN = 1D	TRANSLATION TEST	QK = 0	NOOP
BMX = 0	MASK	PCK = 0	NOOP
CCK = 0	NOOP	RMX = 0	RAMX_D RBMX_Q
CID = 1	UNUSED	SCK = 0	NOOP
DK = 0	NOOP	SGN = 0	NOOP
DT = 0	LONG	SHF = 0	ALU
EALU = 0	A	SI = 3	0 D_0 Q_0
EBMX = 0	FE	SMX = 0	EALU
FEK = 0	NOOP	SPO = 0	NOOP
FS = 0	ENABLE MCT	SUB = 0	NOOP
IBC = 0	NOOP	VAK = 0	NOOP

```

E98      UWORD IN  HEX = 00000003C0180C8003C000E99      UWORD ADDRESS = 0E98

      KEY / 99999988888888887777777776666666665555555554444444443333333332222222221111111110000000000
      \ 54321098765432109876543210987654321098765432109876543210987654321098765432109876543210
      -----
      BINARY = 0000000000000000000000000000111100000000011000000011001000000000000011110000000000000111010011001

      ACF = 0      NOOP
      ACM = 3      TBS
      ADS = 1      PHYSICAL
      ALU = F      A
      AMX = 0      LA
      BEN = 0      NOP
      BMX = 0      MASK
      CCK = 0      NOOP
      CID = 1      UNUSED
      DK = 0      NOOP
      DT = 0      LONG
      EALU= 0      A
      EBMX= 0      FE
      FEK = 0      NOOP
      FS = 0      ENABLE MCT
      IBC = 0      NOOP

      IEK = 0      NOOP
      JMP = E99
      KMX = 0      8
      MCT = 19     READ.P
      MSC = F      INH CM
      QK = 0      NOOP
      PCK = 0      NOOP
      RMX = 0      RAMX_D RBMX_Q
      SCK = 0      NOOP
      SGN = 0      NOOP
      SHF = 0      ALU
      SI = 3      0 D_0 Q_0
      SMX = 0      EALU
      SPO = 0      NOOP
      SUB = 0      NOOP
      VAK = 0      NOOP

      *****

```

```
E99      UWORD IN HEX = 0811003401E009783C000E9A      UWORD ADDRESS = E99

      KEY / 999999888888888877777777766666666655555555544444444433333333322222222211111111110000000000
      \ 54321098765432109876543210987654321098765432109876543210987654321098765432109876543210
      -----
      BINARY = 000010000001000100000000001101000000000111100000000010010111100000111100000000000001110100110101

      ACF = 0      NOOP      IEK = 0      NOOP
      ACM = 3      TBS      JMP = E9A
      ADS = 0      VIRTUAL   KMX = 0      8
      ALU = D      A AND B   MCT = 1      MEM.NOP
      AMX = 1      RAMX      MSC = F      INH CM
      BEN = 0      NOP      QK = C      LOAD D
      BMX = 4      LC      PCK = 0      NOOP
      CCK = 0      NOOP      RMX = 0      RAMX_D RBMX_Q
      CID = 1      UNUSED   SCK = 0      NOOP
      DK = 8      LOAD SHF(INT FORM)  SGN = 0      NOOP
      DT = 0      LONG      SHF = 0      ALU
      EALU = 0     A      SI = 3      0 D_0 Q_0
      EBMX = 0     FE      SMX = 0      EALU
      FEK = 0      NOOP      SPD = 2F     LOAD LC TF
      FS = 0      ENABLE MCT  SUB = 0      NOOP
      IBC = 0      NOOP      VAK = 0      NOOP

      *****
```

E9A UWORD IN HEX = 00141D38018008003E0004CF UWORD ADDRESS = 0E9A

```

KEY / 99999988888888887777777776666666665555555544444444433333333222222221111111110000000000
\ 54321098765432109876543210987654321098765432109876543210987654321098765432109876543210
-----
BINARY = 0000000000010100000111010011100000000001100000000001000000000000011111000000000000010011001111

ACF = 0      NOOP      IEK = 0      NOOP
ACM = 3      TBS       JMP = 4CF
ADS = 0      VIRTUAL   KMx = 0      8
ALU = E      B         MCT = 1      MEM.NOP
AMX = 0      LA        MSC = F      INH CM
BEN = 1D     TRANSLATION TEST  QK = 0      NOOP
BMX = 5      PC        PCK = 0      NOOP
CCK = 0      NOOP      RMX = 0      RAMX_D RBMX_Q
CID = 1      UNUSED    SCK = 0      NOOP
DK = 0       NOOP      SGN = 0      NOOP
DT = 0       LONG      SHF = 0      ALU
EALU = 0     A         SI = 3      0 D_0 Q_0
EBMX = 0     FE        SMX = 0      EALU
FEK = 0      NOOP      SPD = 0      NOOP
FS = 0       ENABLE MCT  SUB = 0      NOOP
IBC = 0      NOOP      VAK = 1      LOAD VA

```

4CF UWORD IN HEX = 0C10003A41803D683C820001 UWORD ADDRESS = 04CF

```

KEY / 99999988888888887777777776666666665555555544444444433333333222222221111111110000000000
\ 54321098765432109876543210987654321098765432109876543210987654321098765432109876543210
-----
BINARY = 00001100000100000000000000011101001000001100000000011101011010000011100100000100000000000000001

ACF = 0      NOOP      IEK = 0      NOOP
ACM = 3      TBS       JMP = 1
ADS = 0      VIRTUAL   KMx = 10     80
ALU = E      B         MCT = 7      LOCKWRITE.V.XCHK
AMX = 0      LA        MSC = F      INH CM
BEN = 0      NOP       QK = 0      NOOP
BMX = 4      LC        PCK = 0      NOOP
CCK = 0      NOOP      RMX = 0      RAMX_D RBMX_Q
CID = 7      ID REG_ID BUS-ID ADR=KMX  SCK = 1      LOAD SC
DK = C       LOAD Q     SGN = 0      NOOP
DT = 0       LONG      SHF = 0      ALU
EALU = 0     A         SI = 3      0 D_0 Q_0
EBMX = 0     FE        SMX = 2      ALU(9:0)
FEK = 0      NOOP      SPD = 2D     LOAD LC TD
FS = 1       ENABLE CID  SUB = 2      RETURN
IBC = 0      NOOP      VAK = 0      NOOP

```

E8C UWORD IN HEX = 00101D3801800971020004AF UWORD ADDRESS = 0E8C

```

KEY / 99999988888888887777777776666666665555555554444444433333333222222221111111110000000000
\ 54321098765432109876543210987654321098765432109876543210987654321098765432109876543210
-----
BINARY = 000000000001000000011101001110000000000110000000000100101110001000000100000000000010010101111

ACF = 0      NOOP      IEK = 0      NOOP
ACM = 3      TBS       JMP = 4AF
ADS = 0      VIRTUAL   KMx = 0      8
ALU = E      B         MCT = 1      MEM_NOP
AMX = 0      LA        MSC = 0      NOOP
BEN = 1D     TRANSLATION TEST  OK = 0      NOOP
BMX = 4      LC        PCK = 1      PC_VA
CCK = 0      NOOP      RMX = 0      RAMX_D RBMX_Q
CID = 1      UNUSED    SCK = 0      NOOP
DK = 0       NOOP      SGN = 0      NOOP
DT = 0       LONG      SHF = 0      ALU
EALU = 0     A         SI = 3      0 D_0 Q_0
EBMX = 0     FE        SMX = 0      EALU
FEK = 0      NOOP      SPO = 2E    LOAD LC TE
FS = 0       ENABLE MCT  SUB = 0      NOOP
IBC = 0      NOOP      VAK = 1      LOAD VA

```

4AF UWORD IN HEX = 0C10003A41803D6800820001 UWORD ADDRESS = 04AF

```

KEY / 99999988888888887777777776666666665555555554444444433333333222222221111111110000000000
\ 5432109876543210987654321098765432109876543210987654321098765432109876543210
-----
BINARY = 0000110000010000000000000001110100100000110000000001110101101000000000010000010000000000000001

ACF = 0      NOOP      IEK = 0      NOOP
ACM = 3      TBS       JMP = 1
ADS = 0      VIRTUAL   KMx = 10     80
ALU = E      B         MCT = 7      LOCKWRITE.V.XCHK
AMX = 0      LA        MSC = 0      NOOP
BEN = 0      NOP       OK = 0      NOOP
BMX = 4      LC        PCK = 0      NOOP
CCK = 0      NOOP      RMX = 0      RAMX_D RBMX_Q
CID = 7      ID REG_ID BUS-ID ADR=KMX  SCK = 1      LOAD SC
DK = C       LOAD Q     SGN = 0      NOOP
DT = 0       LONG      SHF = 0      ALU
EALU = 0     A         SI = 3      0 D_0 Q_0
EBMX = 0     FE        SMX = 2      ALU(9:0)
FEK = 0      NOOP      SPO = 2D    LOAD LC TD
FS = 1       ENABLE CID  SUB = 2      RETURN
IBC = 0      NOOP      VAK = 0      NOOP

```

B61

UWORD IN HEX = 301000380180616800820E68 UWORD ADDRESS = 0B61

KEY / 9999998888888888777777776666666655555555444444443333333322222222111111111000000000
 \ 54321098765432109876543210987654321098765432109876543210987654321098765432109876543210

BINARY = 001100000001000000000000011100000000011000000001100001011010000000000100000100000111001101000

ACF = 0	NOOP	IEK = 0	NOOP
ACM = 3	TBS	JMP = E68	
ADS = 0	VIRTUAL	KMX = 0	8
ALU = E	B	MCT = C	READ.V.NEWPC
AMX = 0	LA	MSC = 0	NOOP
BEN = 0	NOP	OK = 0	NOOP
BMX = 4	LC	PCK = 0	NOOP
CCK = 0	NOOP	RMX = 0	RAMX_D RBMX_Q
CID = 4	IDBUS_ID REG-ID ADR=SC 5:0	SCK = 1	LOAD SC
DK = 0	NOOP	SGN = 0	NOOP
DT = 0	LONG	SHF = 0	ALU
EALU = 0	A	SI = 3	0 D_0 Q_0
EBMX = 0	FE	SMX = 2	ALU(9:0)
FEK = 0	NOOP	SPO = 2D	LOAD LC TD
FS = 0	ENABLE MCT	SUB = 0	NOOP
IBC = 3	START	VAK = 0	NOOP

E68

UWORD IN HEX = 00100038B9F02D6102000F69 UWORD ADDRESS = 0E68

KEY / 9999998888888888777777776666666655555555444444443333333322222222111111111000000000
 \ 54321098765432109876543210987654321098765432109876543210987654321098765432109876543210

BINARY = 000000000001000000000000011100010111001111100000010110101100001000000100000000000111001101001

ACF = 0	NOOP	IEK = 0	NOOP
ACM = 3	TBS	JMP = E69	
ADS = 0	VIRTUAL	KMX = 2E	19
ALU = E	B	MCT = 5	WRITE.V.NOCHK
AMX = 0	LA	MSC = 0	NOOP
BEN = 0	NOP	OK = E	LOAD ID BUS
BMX = 4	LC	PCK = 1	PC_VA
CCK = 0	NOOP	RMX = 0	RAMX_D RBMX_Q
CID = 5	ID BUS_ID REG-ID ADR=KMX	SCK = 0	NOOP
DK = 0	NOOP	SGN = 0	NOOP
DT = 0	LONG	SHF = 0	ALU
EALU = 0	A	SI = 3	0 D_0 Q_0
EBMX = 0	FE	SMX = 0	EALU
FEK = 0	NOOP	SPO = 2C	LOAD LC TC
FS = 1	ENABLE CID	SUB = 0	NOOP
IBC = 0	NOOP	VAK = 1	LOAD VA

E69 UWORD IN HEX = 0C00003EBDF02C0028000002 UWORD ADDRESS = 0E69

KEY / 99999988888888887777777776666666665555555554444444443333333332222222221111111110000000000
 \ 543210987654321098765432109876543210987654321098765432109876543210987654321098765432109876543210

BINARY = 0000110000000000000000000111110101111011111000000101100000000000101000000000000000000000010

ACF = 0	NOOP	IEK = 0	NOOP
ACM = 3	TBS	JMP = 2	
ADS = 0	VIRTUAL	KMX = 2F	FFF9
ALU = F	A	MCT = 5	WRITE,V.NOCHK
AMX = 0	LA	MSC = A	CLR NESTED ERR
BEN = 0	NOP	QK = E	LOAD ID BUS
BMX = 0	MASK	PCK = 0	NOOP
CCK = 0	NOOP	RMX = 0	RAMX_D RBMX_Q
CID = 5	ID BUS_ID REG-ID ADR=KMX	SCK = 0	NOOP
DK = C	LOAD Q	SGN = 0	NOOP
DT = 0	LONG	SHF = 0	ALU
EALU= 0	A	SI = 3	0 D_0 Q_0
EBMX= 0	FE	SMX = 0	EALU
FEK = 0	NOOP	SPO = 0	NOOP
FS = 1	ENABLE CID	SUB = 2	RETURN
IBC = 0	NOOP	VAK = 0	NOOP

62 UWORD IN HEX = F80C003B01F1F857139B6000 UWORD ADDRESS = 0062

KEY / 99999988888888887777777776666666665555555554444444443333333332222222221111111110000000000
 \ 543210987654321098765432109876543210987654321098765432109876543210987654321098765432109876543210

BINARY = 1111100000001100000000000001110110000000111110001111110000101011100010011100110110110000000000000

ACF = 0	NOOP	IEK = 0	NOOP
ACM = 3	TBS	JMP = 0	
ADS = 1	PHYSICAL	KMX = 0	8
ALU = E	B	MCT = 1F	ALLOW,IB.READ
AMX = 0	LA	MSC = 4	IRD STATE
BEN = 0	NOP	QK = E	LOAD ID BUS
BMX = 3	LB	PCK = 7	PC_PC+N
CCK = 1	LOAD UBRANCH CC	RMX = 0	RAMX_D RBMX_Q
CID = 7	ID REG_ID BUS-ID ADR=KMX	SCK = 1	LOAD SC
DK = 8	LOAD SHF(INT FORM)	SGN = 1	SS_ALU15
DT = 0	LONG	SHF = 0	ALU
EALU= 3	B	SI = 3	0 D_0 Q_0
EBMX= 2	AMX EXP	SMX = 3	ALU EXP
FEK = 1	LOAD FE	SPO = A	LOAD LA,LB[RA=SP2R,RB=SP1R]
FS = 0	ENABLE MCT	SUB = 3	CALL DPT
IBC = F	CLR B1-B5 COND	VAK = 1	LOAD VA

009

UWORD IN HEX = 001908181580F8D800000094 UWORD ADDRESS = 0009

KEY / 99999988888888887777777766666666665555555554444444443333333332222222221111111110000000000
 \ 54321098765432109876543210987654321098765432109876543210987654321098765432109876543210

BINARY = 00000000000110010000100000011000000101011000000111110001101100000000000000000000000010010100

ACF = 0	NOOP	IEK = 0	NOOP
ACM = 3	TBS	JMP = 94	
ADS = 1	PHYSICAL	KMX = 5	SP1CON
ALU = 6	A+B(RLOG)	MCT = 1F	ALLOW,IB,READ
AMX = 1	RAMX	MSC = 0	NOOP
BEN = 8	VAX DATA TYPE	QK = 0	NOOP
BMX = 6	KMX	PCK = 0	NOOP
CCK = 0	NOOP	RMX = 0	RAMX_D RBMX_Q
CID = 7	ID REG_ID BUS-ID ADR=KMX	SCK = 0	NOOP
DK = 0	NOOP	SGN = 0	NOOP
DT = 0	LONG	SHF = 0	ALU
EALU = 0	A	SI = 3	0 D_0 Q_0
EBMX = 0	FE	SMX = 0	EALU
FEK = 0	NOOP	SPO = 1B	WRITE RA,RB[PRN]
FS = 0	ENABLE MCT	SUB = 0	NOOP
IBC = 0	NOOP	VAK = 0	NOOP

94

UWORD IN HEX = F00C03F01F0584700000200 UWORD ADDRESS = 0094

KEY / 99999988888888887777777766666666665555555554444444443333333332222222221111111110000000000
 \ 54321098765432109876543210987654321098765432109876543210987654321098765432109876543210

BINARY = 111100000000000110000000011111100000001111100000101100001000111000000000000000000001000000000

ACF = 0	NOOP	IEK = 0	NOOP
ACM = 3	TBS	JMP = 200	
ADS = 0	VIRTUAL	KMX = 0	8
ALU = F	A	MCT = B	READ,V,IBCHK
AMX = 0	LA	MSC = 0	NOOP
BEN = 0	NOP	QK = E	LOAD ID BUS
BMX = 0	MASK	PCK = 7	PC_PC+N
CCK = 0	NOOP	RMX = 0	RAMX_D RBMX_Q
CID = 3	CNSL CONT	SCK = 0	NOOP
DK = 0	NOOP	SGN = 0	NOOP
DT = 3	INST DEP.	SHF = 0	ALU
EALU = 0	A	SI = 3	0 D_0 Q_0
EBMX = 0	FE	SMX = 0	EALU
FEK = 0	NOOP	SPO = 8	LOAD LA,LB[SP1R]
FS = 0	ENABLE MCT	SUB = 3	CALL DPT
IBC = F	CLR B1-B5 COND	VAK = 0	NOOP

224 UWORD IN HEX = C001C03C0180F8DC40700062 UWORD ADDRESS = 0224

KEY / 99999988888888887777777776666666665555555554444444443333333332222222221111111110000000000
 \ 543210987654321098765432109876543210987654321098765432109876543210987654321098765432109876543210

BINARY = 11000000000000001111000000001111000000000110000000111110001101110001000000011100000000000001100010

ACF = 0	NOOP	IEK = 1	ISTR
ACM = 3	TBS	JMP = 62	
ADS = 1	PHYSICAL	KMX = 0	8
ALU = F	A	MCT = 1F	ALLOW,IB,READ
AMX = 1	RAMX	MSC = 0	NOOP
BEN = 0	NOP	OK = 0	NOOP
BMX = 0	MASK	PCK = 4	PC_PC+1
CCK = 7	INST DEP	RMX = 0	RAMX_D RBMX_Q
CID = 7	ID REG_ID BUS-ID ADR=KMX	SCK = 0	NOOP
DK = 0	NOOP	SGN = 0	NOOP
DT = 3	INST DEP.	SHF = 0	ALU
EALU = 0	A	SI = 3	0 D_0 Q_0
EBMX = 0	FE	SMX = 0	EALU
FEK = 0	NOOP	SPO = 1B	WRITE RA,RB[PRN]
FS = 0	ENABLE MCT	SUB = 0	NOOP
IBC = C	CLR B0	VAK = 0	NOOP

```

; PCS,MCR[363,2043]      16:51 7-DEC-1977      MICRO 31(254)  STAR Microcode: PCS C1,
;                               Location / Line Number Index
; Ucode Loc'n      0          1          2          3          4          5          6          7

U 0000      3033:      3037:      3043:      3046:      3049:      3052:      3055:      3061:
U 0008      3067:      3071:      3076:      3081:      3085:      3094:      5730=      3090:
U 0010      17405=     3058      17723=     17453:      3106:      3109:      3112:      3115:
U 0018      3118:      3124:      3127:      3132:      3135:      3138:      5733=      3145:
U 0020      3841=      3845=      3101      11224=     21613:      13334=     16702=     16705=
U 0028      4738=      4741=      21476=     21482=     4744=      13338=     3308:      3299:
U 0030      3162:      11379=     17727=     17390:      3165:      11363=     16708=     16710=
U 0038      3172:      18700=     5969=      18705=     21592:      21595:      19949=     19952=

U 0040      5884:      12670:     6677:      17469:     5894:      17568:     6710:      17738:
U 0048      9785:      10818:     10419:     17501:     17522:     3399:      3410:      3405:
U 0050      8063=      5655=      13447=     22346=     8538=      5659=      17749=     17752=
U 0058      12941=     17618=     3169      22353=     7189=      17940=     7193=      17945=
U 0060      3181:      3184:      3187:      11229=     3205      3233=      5741=      3237=
U 0068      5243=      6203=      5249=      6209=      3089:      6212=      5746=      6215=
U 0070      8067=      8070=      13452=     3209      8545=      8552=      3355      17755=
U 0078      12946=     11434=     13458=     6218=      5940=      11437=     5750=      17949=

U 0080      3250:      3419:      3352:      3422:      3261:      3425:      3431:      3428:
U 0088      18736:     18861:      3436:      17813:      3447:      18114:      3453:      3457:
U 0090      3216=      3219=      3224=      3230=      3193=      3197=      4270=      3200=
U 0098      17982=     17986=     17989=     17993=     17368=     18195=     4275=      18198=
U 00A0      3945=      3948=      9264=      13122=     5173=      5177=      3358      14004=
U 00A8      18741:      3343:      15375=     3380      5183=      5188=      3332:      3336:
U 00B0      13674=     17641=     9270=      13126=     8095=      8101=      4351=      14008=
U 00B8      10209=      3414      15380=     17996=     10213=     18761=      4354=      16764=

U 00C0      3274:      10269:     24792:     24810:     3287:      17553:      3441      4551=
U 00C8      3367:      3386:      3390:      3509      3394:      3372:      3376:      4555=
U 00D0      3651=      3656=      4051=      4054=      3662=      3668=      3672=      3676=
U 00D8      6000=      18613=     12934=     18619=     17373=     19004=     12937=     19008=
U 00E0      3311=      3314=      3318=      3323=      3516      3728=      5665=      3731=
U 00E8      5373=      3852=      5378=      3856=      6757=      3860=      5669=      3863=
U 00F0      13678=     13680=     9274=      13131=     9773=      9776=      16613=     14016=
U 00F8      13686=     12987=     15385=     18623=     6761=      12990=     6764=      24462:

U 0100      8202:      22196:     22274:     22140:     22401:     22045:     21620:     24025:
U 0108      24017:     21363=     8834=      21368=     24009:     23949:     21693:     23927:
U 0110      17407=     24763:      3522      17457:     10880=     3549      4213=      4219=
U 0118      3575      18651=     8844=      18657=     21322=     21328=     21333=     21338=
U 0120      24499:     24568:     24639:     24658:     24681:     24694:     15936=     24470:
U 0128      3580      24716:     24729:      3685      15601=     3991=      15604=     3994=
U 0130      13841=     15365=     17731=     17460:     13843=     5229=      15941=     5233=
U 0138      4766=      4770=      5974=      18661=     4773=      3689      5980=      5982=

U 0140      14913=     12674:     5428=      5435=      5898:      18478=     4293=      4300=
U 0148      15164=     21409=     10422:     21414=     5903:      5906:      5911:      5914:
U 0150      5415=      5418=      15837=     17472:      3695      17572:     5364=      5368=
U 0158      5422=      17620=     16721=     17504:     17524:     21642=     16723=     21646=
U 0160      14922=     3699      5625=      3978=      3705      18483=     5629=      3982=
U 0168      15169=     10587=      3735      3986=      10593=     10598=     7645=      7648=
U 0170      14926=     15369=     15839=     17474:     10884=     13737=     15947=     17758=
U 0178      22650=     22654=     22659=     22664=     5945=      13741=     5951=      5953=

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; PCS,MCR[363,2043]      16:51 7-DEC-1977      MICRO 31(254)      STAR Microcode: PCS 01,
;                          Location / Line Number Index
; Ucode Loc'n    0      1      2      3      4      5      6      7

U 0180      5440= 4404= 6838= 6845= 5443= 5447= 6852= 6859=
U 0188      10608= 4407= 6864= 6870= 10614= 14779= 3795 14783=
U 0190      11553= 3849 6876= 6881= 3894 14499= 8783= 14509=
U 0198      13493= 13496= 6885= 6889= 13504= 13507= 8788= 14787=
U 01A0      15981= 4442= 15952= 6893= 3904 5301= 5758= 5305=
U 01A8      10698= 4448= 18992= 6897= 10702= 14938= 5764= 14941=
U 01B0      15986= 17643= 15957= 6901= 13603= 16829= 13606= 14516=
U 01B8      15995= 15999= 18997= 6905= 3908 16831= 5769= 14944=

U 01C0      5330= 10273= 5335= 5134= 11699= 11704= 16618= 5139=
U 01C8      4334= 4341= 19013= 4091= 4096= 4100= 4105= 4110=
U 01D0      4657= 4662= 5340= 5145= 18425= 4006 16622= 5150=
U 01D8      6005= 21440= 19017= 21444= 6010= 6012= 6016= 6017=
U 01E0      3712= 3715= 3719= 3725= 4223= 4228= 4234= 4239=
U 01E8      8217= 6234= 15586= 6239= 19810= 6242= 15589= 6245=
U 01F0      11559= 11562= 15962= 4057 18430= 18434= 16628= 14521=
U 01F8      8235= 4061 4197 6248= 19818= 21785= 15591= 21791=

U 0200      3472= 3475= 3481= 3484= 3489= 3498= 3505= 3525=
U 0208      3530= 3534= 3540= 3544= 3556= 3567= 4038= 3572=
U 0210      3798= 3801= 3805= 3811= 3585= 3588= 3591= 3594=
U 0218      3597= 3603= 3606= 3612= 3615= 3618= 4331 3625=
U 0220      6196= 6279= 4360 3788= 3495= 6690= 3512= 3780=
U 0228      7120= 7154= 5488= 5493= 5402= 5162= 6748= 5962=
U 0230      3826= 3829= 3833= 3838= 4250= 6693= 4255= 4260=
U 0238      22684= 22688= 22693= 22697= 22984= 22990= 22996= 23002=

U 0240      5933= 4086= 6727= 7659= 5923= 7623= 6734= 7552=
U 0248      3890= 4023= 4030= 4129= 4119= 3873= 3882= 7444=
U 0250      5388= 4368 5392= 7663= 4372 7627= 5634= 5638=
U 0258      22801= 22807= 22812= 22816= 23098= 23103= 23108= 23114=
U 0260      15224= 15228= 15230= 15233= 4305= 4310= 4316= 4321=
U 0268      15238= 15241= 15246= 15248= 3561= 4416 4041= 4047=
U 0270      5474= 5478= 4383= 4389= 12693= 12696= 4395= 4400=
U 0278      5482= 4422 4425 23471= 3635= 3638= 3642= 23475=

U 0280      5453= 5457= 14370= 14626= 18386= 4079= 4134= 3630=
U 0288      21755= 17921= 17966= 4002= 4068= 4073= 3915= 3901=
U 0290      12894= 4432 14374= 14631= 5122= 5123= 5124= 5125=
U 0298      4437 17924= 17970= 4462 13578= 23190= 17428= 23193=
U 02A0      5348= 5263= 5353= 5269= 6787= 5273= 16765= 5279=
U 02A8      3823= 4541 14840= 14844= 14145= 14149= 16768= 3768=
U 02B0      4546 5310= 5358= 5315= 6790= 5319= 16771= 5323=
U 02B8      9859= 4011= 14847= 4014= 13583= 23319= 17431= 23323=

U 02C0      3746= 7638= 5538= 5543= 3757= 7671= 4563 19053=
U 02C8      8123= 8127= 8128= 8132= 7508= 7571= 3958= 3925=
U 02D0      4576 7642= 4983= 4987= 7375= 7675= 4991= 4994=
U 02D8      8133= 8138= 6492= 8142= 7380= 23335= 6498= 23340=
U 02E0      5497= 6378= 8647= 6382= 5500= 5503= 8652= 19056=
U 02E8      14822= 4709= 8658= 4712= 14826= 4715= 4614 4718=
U 02F0      12899= 4637 14378= 14636= 14268= 14271= 8894= 19059=
U 02F8      9865= 9868= 9871= 9876= 13586= 4699 8899= 19063=

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; PCS,MCR[363,2043]      16:51 7-DEC-1977      MICRO 31(254)      STAR Microcode: PCS v1,
;
; Ucode Loc'n      0      1      2      3      4      5      6      7
;
U 0300      4795:      4798:      4803:      4806:      4810:      4818:      4824:      4842:
U 0308      4847:      4851:      4857:      4861:      4872:      4883:      4753:      4887:
U 0310      5601=      5607=      15644=      15648=      4900:      4903:      4906:      4909:
U 0318      4912:      4917:      4920:      4925:      4928:      4931:      4758:      4938:
U 0320      5612=      5617=      4706      6339=      4815:      7125=      4831:      6345=
U 0328      15391=      10068=      11284=      10076=      15396=      10081=      11288=      10090=
U 0330      4734      21500=      15653=      21506=      5508=      7129=      5511=      5514=
U 0338      10325=      21510=      15618=      21513=      14528=      14531=      15621=      10101=

U 0340      13666:      4971:      13443:      4287:      4977:      4607:      4455:      19363:
U 0348      8736:      4160:      4179:      4170:      4207:      4193:      8532:      24845:
U 0350      5080=      5081=      5082=      5083=      5084=      5085=      5086=      5087=
U 0358      5643=      5646=      15627=      24067=      14552=      14555=      15631=      24070=
U 0360      7164=      6508=      13321=      6513=      5674=      5679=      13323=      4566=
U 0368      8743:      8749:      13327=      4762      4877:      4779      4828      4569=
U 0370      7168=      6554=      15656=      6559=      5521=      4834      5526=      5531=
U 0378      10331=      10334=      10337=      10343=      4946:      4949:      4957:      4960:

U 0380      5466:      5199:      6367:      4726:      8053:      24804:      24826:      4943:
U 0388      5563:      5297:      6781:      7182:      7140:      6312:      5993:      6226:
U 0390      5777=      5780=      4839      4730:      4866      8638=      24830:      8642=
U 0398      6260=      15968=      6262=      7186:      7143:      15971=      24452=      24456=
U 03A0      5089=      5090=      5091=      5092=      5093=      5094=      5095=      5096=
U 03A8      19829=      10108=      16477=      10112=      19837=      10116=      16480=      10121=
U 03B0      5101=      5102=      5103=      5104=      5105=      5106=      5107=      5108=
U 03B8      3928=      3931=      3935=      3941=      6295=      6297=      4890      10127=

U 03C0      4187:      5830:      24786:      11218:      4511:      7048:      11547:      4895
U 03C8      24819:      5724:      14763:      15354:      16588:      15932:      18474:      18339:
U 03D0      6300=      6303=      5000      11220:      4517:      4523:      4529:      4535:
U 03D8      6329=      6331=      14767:      15359:      24485=      24488=      24491=      24494=
U 03E0      6355=      6357=      5004      7426=      6621=      6627=      11550:      7431=
U 03E8      3961=      3964=      3968=      3974=      6592=      15211=      6597=      15215=
U 03F0      5111=      5112=      5113=      5114=      5115=      5116=      5117=      5118=
U 03F8      5010      7559=      14772:      7562=      6610=      5015      6613=      15219=

U 0400      8353:      8356:      8359:      8362:      8368:      8377:      8383:      8392:
U 0408      8399:      8403:      8408:      8411:      8420:      8430:      5142      8434:
U 0410      10889=      5167      5593=      5596=      8447:      8450:      8453:      8456:
U 0418      8459:      8464:      8472:      8478:      8481:      8484:      7680=      7684=
U 0420      6950=      24697=      6954=      16021=      8374:      18922=      8389:      16025=
U 0428      6911=      6914=      17672=      16029=      7008=      7012=      17674=      22827=
U 0430      5225      24700=      6386=      6388=      7604=      18925=      13546=      16032=
U 0438      24707=      24710=      5238      16036=      7610=      18928=      13549=      22832=

U 0440      7041=      7047=      13989:      14355:      18935=      18949=      14930=      23026=
U 0448      24799:      7595=      9142:      7599=      7051=      7054=      9161:      23031=
U 0450      10893=      10896=      10899=      10904=      18938=      18952=      14934=      23036=
U 0458      4465=      4468=      4472=      4479=      18943=      18957=      9168:      23042=
U 0460      12534=      4484=      17838=      4487=      5252      4490=      17843=      4494=
U 0468      12537=      4498=      9145:      4502=      8424:      5257      7798=      7800=
U 0470      7386=      7389=      7692=      7697=      6970=      5285      6975=      7700=
U 0478      4588=      4591=      4595=      4600=      8494:      8497:      8350:      8503:

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; PCS,MCR[363,2043]      16:51 7-DEC-1977      MICRO 31(254)      STAR Microcode: PCS 01,
;                               Location / Line Number Index
; Ucode Loc'n      0      1      2      3      4      5      6      7

U 0480      8698:      8693:      8672:      10502:      12888:      13116:      10303:      8489:
U 0488      9851:      13106:      10872:      24834:      13994=      17611=      8682:      8685:
U 0490      10169=      12591=      5383      10506:      10172=      12907=      14134=      4579=
U 0498      10175=      12595=      10875:      24840:      10178=      12911=      14139=      4582=
U 04A0      4617=      4620=      4624=      4631=      7854=      18963=      7769=      7772=
U 04A8      4640=      4643=      4646=      4649=      7075=      17613=      7078=      23163=
U 04B0      7267=      5407      7274=      8245=      7857=      18966=      7865=      8250=
U 04B8      4665=      4668=      4671=      4674=      7282=      18971=      7286=      23167=

U 04C0      17634=      14620:      10486:      5410      18866=      13903:      8291=      8294=
U 04C8      4681=      4685=      4689=      4692=      7294=      15203=      7300=      23258=
U 04D0      5020=      5023=      5028=      5033=      7749=      7752=      7755=      7758=
U 04D8      6523=      6531=      6539=      6547=      7325=      15205=      7331=      23262=
U 04E0      17637=      8177=      10490:      8182=      18871=      8706=      10307:      8710=
U 04E8      9854:      5840=      5469      5843=      13998=      5847=      5548      5850=
U 04F0      7354=      5552      7357=      9015=      7585=      7589=      10310:      9018=
U 04F8      8507=      6030=      8511=      6035=      8774=      6040=      8777=      6045=

U 0500      19072=      5569      19076=      19080=      7780=      7783=      5204=      5208=
U 0508      19084=      19088=      19092=      19096=      19102=      19106=      5213=      5218=
U 0510      19112=      19116=      19120=      19124=      19127=      19131=      5786=      5790=
U 0518      19139=      19143=      19147=      19152=      19155=      19158=      5794=      5798=
U 0520      19164=      19168=      19172=      19175=      19180=      19183=      14256=      6089=
U 0528      19189=      19193=      19196=      19199=      19203=      19207=      14260=      6093=
U 0530      19215=      19219=      19223=      19227=      19231=      19235=      19238=      6097=
U 0538      19246=      19249=      19252=      19255=      19259=      19263=      19267=      6099=

U 0540      19385=      5622      19389=      19393=      7812=      7814=      7087=      7091=
U 0548      19400=      19406=      19411=      19417=      19425=      19431=      7095=      7099=
U 0550      19439=      19445=      19450=      19455=      19460=      19464=      15019=      7104=
U 0558      19471=      19475=      19478=      19482=      19485=      19488=      15024=      7108=
U 0560      19494=      19497=      19501=      19505=      19510=      19513=      15540=      7488=
U 0568      19519=      19523=      19526=      19529=      19533=      19537=      15543=      7492=
U 0570      19545=      19549=      19553=      19557=      19561=      19564=      19570=      7533=
U 0578      19580=      19586=      19592=      19595=      19599=      19605=      19608=      7537=

U 0580      6798=      6803=      6807=      6811=      5573=      15507=      5579=      5584=
U 0588      14361=      6283=      5650      6285=      5652      6287=      5588=      6289=
U 0590      14793=      5801      5855=      5859=      16733=      15510=      5861=      5864=
U 0598      7959=      7964=      5868=      5872=      9223=      7973=      9230=      7976=
U 05A0      16938=      18979=      6058=      6061=      7999=      8002=      6064=      6067=
U 05A8      8025=      8028=      6070=      6073=      8281=      8284=      9060=      9064=
U 05B0      16942=      18982=      6817=      6822=      16738=      9195=      7870=      9204=
U 05B8      11591=      18987=      7449=      7452=      9589=      9595=      7875=      7879=

U 05C0      24683=      13139=      5805      6106=      9242=      5810      9247=      6109=
U 05C8      9381=      13142=      9389=      6111=      10157=      10160=      10163=      10166=
U 05D0      24686=      6121=      14166=      6123=      5835      6126=      14171=      6129=
U 05D8      24688=      9394=      14175=      9398=      9420=      6077      9425=      6132=
U 05E0      6079      6140=      14200=      6142=      6083      6145=      14203=      6148=
U 05E8      14366=      10011=      14207=      10015=      9492=      6085      9498=      6150=
U 05F0      14797=      6156=      6101      6159=      16743=      6162=      10636=      6165=
U 05F8      11595=      11598=      11601=      11604=      9671=      9677=      16640=      6168=

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; PCS,MCR[363,2043]      16:51 7-DEC-1977      MICRO 31(254)      SIAR Microcode: PCS v1,
;                               Location / Line Number Index
; Ucode Loc'n      0      1      2      3      4      5      6      7

U 0600      19366= 6173=  16593= 6175=  6103      6178=  17798= 6181=
U 0608      7203=  7208=  7213=  7218=  9881=  9884=  17800= 6183=
U 0610      7456=  6113      7460=  7465=  8558=  8563=  8569= 8572=
U 0618      9524=  6316=  9532=  6318=  9645=  6320=  9653= 6323=
U 0620      19369= 6116      14024= 6394=  9765=  6134      9770= 6396=
U 0628      9966=  9969=  14029= 6400=  10194= 10197= 10201= 10204=
U 0630      19372= 14389= 14651= 6406=  10350= 10355=  6136      6409=
U 0638      19376= 14391= 14654= 6413=  11259= 11263= 11266= 11269=

U 0640      10576= 10580= 16778= 6419=  10632= 10637= 10780= 6421=
U 0648      10784= 10787= 16783= 6425=  6199      11308= 16787= 11311=
U 0650      7472=  6230      7478=  7483=  8593=  8598=  8603= 8606=
U 0658      10806= 10809= 6430=  6433=  10527= 6256      10531= 6436=
U 0660      17056= 6634=  16599= 6639=  6265      6645=  18562= 6651=
U 0668      7516=  6268      7522=  7527=  10909= 10912=  18567= 6655=
U 0670      17060= 10054= 16602= 10059=  8755=  8759=  8765= 8768=
U 0678      10917= 10921= 6987=  6993=  10975= 10979=  6281      0999=

U 0680      7824=  7828=  7832=  6314      8851=  8855=  8860= 8863=
U 0688      11275= 7905=  11279= 7910=  11370= 7916=  11374= 7921=
U 0690      11387= 7934=  11390= 7939=  6349      7944=  21802= 7948=
U 0698      7884=  7887=  7891=  7898=  10984= 10988=  21807= 7952=
U 06A0      11001= 11005= 16644= 7983=  11011= 11014=  6352      7990=
U 06A8      11068= 11071= 16647= 7994=  11126= 11130=  11362= 11365=
U 06B0      8011=  6373      8015=  8019=  11299= 11303=  9291= 9296=
U 06B8      11581= 11585=  8032=  8035=  11644= 11654=  8038= 8042=

U 06C0      8104=  8107=  8111=  8117=  9303=  9307=  9315= 9322=
U 06C8      11775= 11778=  6457      9439=  11785= 11791=  6465      9448=
U 06D0      11841= 11848=  8150=  8154=  11856= 11860=  9802= 9806=
U 06D8      8994=  10650= 8999=  10656=  11959= 11963=  9810= 9814=
U 06E0      9330=  9335=  9341=  9346=  9352=  9359=  9367= 9374=
U 06E8      12684= 9945=  12688= 9949=  13055= 9953=  13057= 9957=
U 06F0      12073= 12078=  9211=  9216=  12106= 12109=  9479= 9484=
U 06F8      13803= 9984=  13807= 9988=  13928= 9992=  13932= 9995=

U 0700      20787= 20564= 20572= 20586= 20608= 20621= 20639= 20649=
U 0708      20791= 20568= 20575= 20603= 20611= 20629= 20645= 20653=
U 0710      18000= 20405= 20415= 20446= 20454= 20471= 20499= 20512=
U 0718      18003= 20411= 20435= 20450= 20457= 20481= 20503= 20516=
U 0720      6471      21669= 21674= 21167= 19976= 20038=  9576= 9580=
U 0728      9455=  9462=  9469= 21172=  12122= 12127=  17650= 20844=
U 0730      19985= 6476      9752=  9757=  19988= 9505=  6482      9510=
U 0738      19995= 10667= 20420= 10670=  19998= 6503      17652= 20746=

U 0740      12150= 12154=  17762= 9543=  12222= 12227=  9551= 9559=
U 0748      14035= 10390=  14038= 10394=  14048= 10398=  14052= 10403=
U 0750      20073= 20241=  17765= 20158=  20024= 6565      6568      20292=
U 0758      20308= 6572      20432= 10618=  12262= 12265=  20224= 10623=
U 0760      20005= 20008=  20011= 6578      20799= 9634=  21196= 9639=
U 0768      6602      20795=  11745=  11749=  12282= 12285=  21201= 11753=
U 0770      9613=  6661      9623=  9627=  20733= 6665      6668      11797=
U 0778      6680      20763=  20423= 6683      20523= 20526=  20531= 11801=

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; PCS,MCR[363,2043]      16:51 7-DEC-1977      MICRO 31(254)  STAR Microcode: PCS 01,
;                               Location / Line Number Index
; Ucode Loc'n      0      1      2      3      4      5      6      7
U 0780      12296= 12301= 6697   11872= 12313= 12317= 6702   11880=
U 0788      21679= 6713   6717   11889= 12354= 12359= 6738   11893=
U 0790      21664= 6751   10746= 10751= 12363= 12369= 6768   11904=
U 0798      21684= 10775= 6773   10780= 12375= 12379= 6920   11909=
U 07A0      20049= 20061= 20064= 9704=  20067= 20053= 20057= 9707=
U 07A8      21052= 6925   20130= 20106= 20980= 20930= 21123= 20850=
U 07B0      10549= 6928   10554= 10558= 12413= 12418= 9660=  9664=
U 07B8      20353= 6934   6939   20345= 20349= 6945   20366= 20755=

U 07C0      14102= 10939= 14106= 10943= 12426= 12430= 20810= 20872=
U 07C8      20886= 20818= 6959   20826= 20830= 20897= 20892= 20864=
U 07D0      14291= 20244= 14294= 20161= 20520= 20254= 20171= 20311=
U 07D8      20314= 20183= 6964   20210= 6981   21689= 20236= 20267=
U 07E0      12462= 12467= 9889=  9896=  20807= 7005   9903=  9910=
U 07E8      7017   20803= 11663= 11668= 12479= 12483= 11926= 11932=
U 07F0      13312= 13315= 9916=  9921=  20736= 7022   9926=  9931=
U 07F8      14978= 20774= 14980= 11968= 14082= 14086= 7027   11971=

U 0800      11165= 11168= 11171= 11175= 14282= 14285= 7032   12026=
U 0808      11180= 11186= 7036   11190= 14400= 14405= 7069   12031=
U 0810      17354= 11343= 17357= 11346= 14412= 14416= 7072   12037=
U 0818      18237= 12139= 18240= 12144= 14437= 14443= 7082   12040=
U 0820      14673= 14678= 12490= 12500= 14682= 14685= 9937=  9940=
U 0828      15521= 15525= 7157   12273= 15548= 15551= 7224   12278=
U 0830      15682= 15684= 7229   12322= 16097= 16101= 7233   12327=
U 0838      16135= 16138= 7237   12332= 16202= 16205= 7240   12338=

U 0840      12718= 12721= 12724= 12731= 16245= 16248= 9976=  9979=
U 0848      17168= 17171= 12383= 12391= 17740= 17743= 7247   12398=
U 0850      12919= 12926= 7255   12929= 17788= 17791= 10045= 10048=
U 0858      17853= 17857= 12964= 12968= 18666= 12547= 18672= 12550=
U 0860      10253= 7260   10257= 11233= 10260= 7309   10373= 10377=
U 0868      12736= 12743= 12750= 12753= 12756= 12761= 12766= 12769=
U 0870      17933= 17937= 13048= 13051= 17954= 17957= 10643= 10646=
U 0878      19686= 12814= 19690= 12818= 19753= 12823= 19756= 12828=

U 0880      17974= 17977= 13276= 13279= 18014= 18017= 10677= 10680=
U 0888      18053= 18058= 13292= 13295= 19876= 13001= 19882= 13005=
U 0890      18263= 18268= 13346= 13349= 18346= 18350= 10962= 10965=
U 0898      18396= 18402= 7317   13032= 18409= 18415= 7340   13035=
U 08A0      18452= 18456= 7348   13153= 18574= 18578= 7362   13159=
U 08A8      18583= 18589= 7367   13162= 18789= 18793= 13169= 13172=
U 08B0      19323= 19326= 13355= 13358= 19338= 19342= 11029= 11032=
U 08B8      19649= 19653= 7371   13177= 19656= 19659= 7400   13182=

U 08C0      19702= 19706= 13364= 13367= 19931= 11327= 19934= 11331=
U 08C8      21073= 13530= 21076= 13538= 19709= 19713= 13190= 13192=
U 08D0      19796= 19800= 13786= 13790= 19858= 19862= 11335= 11338=
U 08D8      19887= 19892= 7407   13201= 20137= 20140= 7411   13204=
U 08E0      21715= 21718= 13832= 13836= 21874= 21879= 11350= 11353=
U 08E8      23672= 23676= 13918= 13922= 23700= 23703= 13229= 13234=
U 08F0      23795= 23799= 14062= 14068= 23804= 23808= 11722= 11726=
U 08F8      23834= 23839= 13248= 13251= 21295= 7416   21299= 13256=

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; PCS,MCR[363,2043]      16:51 7-DEC-1977      MICRO 31(254)      SIAR Microcode: PCS #1,
;                               Location / Line Number Index
; Ucode Loc'n      0          1          2          3          4          5          6          7

U 0900      23845= 23848= 14429= 14433= 11759= 11762= 11765= 11768=
U 0908      21633= 14483= 21636= 14491= 23854= 23857= 13711= 13714=
U 0910      21703= 7421  21709= 13721= 22562= 7497  22567= 13725=
U 0918      23485= 7513  23489= 13730= 24144= 14299= 24147= 14301=
U 0920      7542  14538= 7556  14540= 23981= 23984= 7579  13768=
U 0928      23996= 23999= 14853= 14857= 24231= 24236= 7689  13772=
U 0930      11807= 11812= 11816= 11820= 11824= 11828= 11833= 11836=
U 0938      24266= 24269= 14862= 14867= 24350= 24353= 14448= 14452=

U 0940      24383= 24387= 14993= 14997= 7739  11916= 7743  11921=
U 0948      24534= 24538= 15003= 15006= 14465= 14469= 14473= 14479=
U 0950      24603= 24609= 7763  14875= 24615= 24619= 7776  14878=
U 0958      24630= 24632= 7802  14883= 24650= 24653= 7806  14886=
U 0960      24669= 24673= 15011= 15014= 24737= 24740= 11938= 11941=
U 0968      24748= 24752= 15031= 15033= 7808  14901= 7836  14904=
U 0970      15139= 15143= 7927  15146= 7980  8058  8074  14949=
U 0978      8080  15193= 8084  15196= 8088  8143  8158  14953=

U 0980      8163  8167  8172  14958= 8207  8210  8254  14960=
U 0988      8271  8275  8297  14962= 8300  15099= 8303  15103=
U 0990      15423= 15428= 15432= 15434= 8306  11980= 8310  11985=
U 0998      8313  8318  15465= 15468= 8321  15131= 8324  15133=
U 09A0      8329  8416  15497= 15500= 8437  12049= 8442  12052=
U 09A8      8469  8514  8518  15152= 8585  8611  8615  15156=
U 09B0      8626  8702  12084= 12089= 8715  8719  12093= 12098=
U 09B8      8791  8794  15819= 15822= 8797  15184= 8602  15188=

U 09C0      16050= 16054= 16057= 16059= 8807  8811  12113= 12116=
U 09C8      8815  8818  8821  15255= 8826  8872  8878  15257=
U 09D0      8886  8905  16151= 16154= 8909  8916  8920  15450=
U 09D8      8925  8928  16191= 16195= 8933  8938  8942  15453=
U 09E0      8945  8949  16273= 16276= 8970  8976  9002  15457=
U 09E8      9010  9013  16657= 16661= 9037  9041  9045  15459=
U 09F0      9049  9054  9087  15481= 9092  9096  9148  15484=
U 09F8      9152  9156  9180  15487= 9183  9188  9192  15490=

U 0A00      9253  9278  16800= 16804= 9404  12161= 9412  12165=
U 0A08      9517  9566  9603  15609= 9687  9713  9717  15612=
U 0A10      9720  9749  9790  15739= 9793  9798  10007  15743=
U 0A18      10019  10024  10027  15747= 10030  10033  15786= 15790=
U 0A20      10038  10189  16809= 16812= 10217  10231  10248  15769=
U 0A28      17510= 10313  17512= 17515= 10317  10321  10361  15772=
U 0A30      10366  10384  17537= 17539= 10493  12170= 10497  12175=
U 0A38      10520  10523  10536  15809= 10563  10602  10660  15813=

U 0A40      18502= 18508= 18514= 10720  10724  10729  12437= 12440=
U 0A48      18531= 18535= 18538= 10733  10739  10758  16084= 16087=
U 0A50      18681= 18686= 18690= 10761  10766  10771  12445= 12450=
U 0A58      10790  10794  10822  16122= 10826  10830  10833  16126=
U 0A60      12774= 12781= 12789= 12792= 12796= 12801= 12805= 12808=
U 0A68      18715= 18719= 18723= 18728= 10947  10953  16167= 16170=
U 0A70      10958  10971  20115= 20119= 10996  11020  12833= 12838=
U 0A78      11025  11039  11050  16178= 11054  11057  11064  16180=

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; PCS,MCR[363,2043]      16:51 7-DEC-1977      MICRO 31(254)      STAR Microcode: PCS 01,
;                               Location / Line      Number Index
; Ucode Loc'n      0      1      2      3      4      5      6      7
U 0A80      11082      11087      20176=      20180=      11091      11095      12952=      12955=
U 0A88      11100      11110      11115      16232=      11121      11140      11144      16236=
U 0A90      11148      11160      11239      13009=      11293      11315      11319      13012=
U 0A98      11322      11394      11397      16319=      11400      11403      11408      16322=
U 0AA0      11411      11419      11430      13040=      11566      11569      11573      13044=
U 0AA8      11577      11627      11633      16368=      11639      11658      11676      16372=
U 0AB0      11681      11687      20189=      20192=      11708      11712      11718      16405=
U 0AB8      11730      11736      20217=      20220=      11950      11974      11990      16407=

U 0AC0      11998      12003      20258=      20262=      12007      12014      12018      16413=
U 0AC8      12022      12043      20272=      20275=      12058      12133      12180      16416=
U 0AD0      12186      12191      12194      16444=      12199      12204      12211      16449=
U 0AD8      12216      12231      12235      16454=      17181=      17183=      17185=      17188=
U 0AE0      12238      12244      20283=      20286=      12250      13219=      12255      13222=
U 0AE8      12270      12291      12304      16486=      12309      12345      12350      16488=
U 0AF0      12402      12405      20358=      20361=      12458      16850=      12475      16853=
U 0AF8      12505      12509      20370=      20373=      12514      16856=      12523      16860=

U 0B00      12526      20749=      12530      20752=      12542      12553      12557      16865=
U 0B08      12561      20853=      12571      20856=      12577      12583      12587      16868=
U 0B10      12600      12603      20935=      20938=      12606      12610      12651      16984=
U 0B18      12655      12659      20984=      20988=      12679      12702      12708      16987=
U 0B20      21421=      21425=      12712      21432=      12978      12982      13015      16992=
U 0B28      13019      13022      21760=      21765=      13025      13059      13110      16995=
U 0B30      21817=      21821=      21825=      21829=      13134      13146      13240=      13243=
U 0B38      13195      17144=      13263      17146=      13266      17150=      13270      17154=

U 0B40      21851=      21856=      21861=      21864=      13286      13303      13306      17410=
U 0B48      22058=      22065=      22070=      22076=      13463      13482      13510      17412=
U 0B50      22154=      22159=      22164=      22170=      13469=      13553      13474=      13478=
U 0B58      22296=      22303=      22307=      22311=      13557      13565      17479=      17482=
U 0B60      22491=      22497=      22501=      22506=      13567      13569      13518=      13520=
U 0B68      22522=      22526=      22530=      13590      13592      17528=      13595      17530=
U 0B70      22704=      22708=      22713=      13598      13690      13717      17656=      17658=
U 0B78      23124=      23130=      23134=      23139=      13751      13755      17662=      17666=

U 0B80      23762=      23765=      23768=      13761      13794      13699=      13798      13703=
U 0B88      24242=      24245=      24249=      13810      13822      17829=      13825      17832=
U 0B90      24273=      24277=      24280=      24283=      13846      13907      13777=      13780=
U 0B98      14041      14072      14077      18184=      14159      14178      14181      18189=
U 0BA0      24291=      24295=      24298=      24303=      14186      14194      14211      18201=
U 0BA8      14217      14222      14232      14237      14241      14245      14249      18205=
U 0BB0      14275      14278      14385      14394      14420      14424      14544      18215=
U 0BB8      14643      14647      14661      14665      14668      14800      14805      18218=

U 0BC0      14808      14811      14815      13815=      14818      14828      14831      13819=
U 0BC8      14892      14897      14906      18227=      14973      15073      15076      18230=
U 0BD0      15079      15083      15093      15105      15108      15159      15399      18325=
U 0BD8      18287=      18292=      18297=      18302=      18305=      15402      15405      18328=
U 0BE0      15408      15436      15440      15444      15470      15472      14092=      14096=
U 0BE8      15476      15493      15528      15530      15534      18594=      15562      18599=
U 0BF0      15565      15568      15570      15573      15578      15596      14126=      14128=
U 0BF8      15659      15669      15672      18818=      15677      15688      15691      18825=

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; PCS,MCR[363,2043]      16151 7-DEC-1977      MICRO 31(254)      STAR Microcode: PCS v1.
;                               Location / Line Number Index
; Ucode Loc'n      0      1      2      3      4      5      6      7
U 0C00      15758      15762      15777      15793      15797      15832      14561=      14564=
U 0C08      15841      15845      15974      18838=      15976      16004      16008      14842=
U 0C10      16039      16062      16065      16091      16105      14968=      16109      14971=
U 0C18      16141      16145      16158      18877=      16161      16173      16183      18882=
U 0C20      16198      16218      16221      16224      16256      16259      15047=      15050=
U 0C28      16264      16268      16279      18893=      16282      16288      16290      18898=
U 0C30      16294      16297      16311      16333      16349      15059=      16352      15065=
U 0C38      16356      16359      16363      16389      16392      19679=      16395      19683=

U 0C40      16399      16421      16439      16465      16469      15122=      16473      15127=
U 0C48      16501      16503      16505      19896=      16507      16509      16606      19901=
U 0C50      16675      16713      16717      16773      16791      16888      16891      20229=
U 0C58      16894      16896      16899      16902      16917      16931      9177=      20233=
U 0C60      16935      16944      16964      16967      17016      17020      17023      19905=
U 0C68      17048      17052      17079      17106      17135      17140      19908=      19912=
U 0C70      17197      17223      17226      17229      17231      15174=      17235      15178=
U 0C78      17239      17249      17276      17280      17291      17294      20297=      20302=

U 0C80      17296      17299      17302      15262=      17304      17311      17314      15265=
U 0C88      17317      17321      17324      17329      17336      17344      20324=      20329=
U 0C90      17347      17351      17363      10516=      17393      17397      17399      20834=
U 0C98      17401      17425      17433      17435      17438      17441      17444      20838=
U 0CA0      17487      17532      17542      15270=      17546      17558      17578      15273=
U 0CA8      17582      17607      17615      17625      17631      17645      20876=      20880=
U 0CB0      17647      17681      17684      17686      17689      17694      21152=      21157=
U 0CB8      17697      17700      17720      17802      17805      21771=      21162=      21775=

U 0CC0      17816      17820      17824      17848      17882      17885      21182=      21186=
U 0CC8      17890      17894      17897      23935=      17901      17904      21191=      23940=
U 0CD0      17907      17911      17928      18011      18021      18025      18029      21215=
U 0CD8      18040      18064      18096      18099      18117      18122      18126      21220=
U 0CE0      18131      18147      18154      18157      18161      18168      15698=      15702=
U 0CE8      18173      18179      18212      18222      21390=      21395=      21398=      21402=
U 0CF0      18234      18243      18247      18254      18260      18279      18318      21488=
U 0CF8      18322      18354      18357      18363      18367      18372      18377      21494=

U 0D00      18391      18440      18443      18448      18459      18464      18487      21624=
U 0D08      18491      18496      18523      18527      18608      18642      18646      21627=
U 0D10      18677      18695      18711      15712=      18745      18749      18757      15716=
U 0D18      18771      18775      18780      18785      22093=      22099=      22105=      22111=
U 0D20      18799      18803      18808      15724=      18812      18832      18845      15729=
U 0D28      18849      18854      18887      18906      22210=      22214=      22219=      22224=
U 0D30      18910      18913      18917      15754=      19023      19027      19032      15756=
U 0D38      19038      19041      19046      19276      22325=      22329=      22333=      22337=

U 0D40      19280      19286      19290      19295      19298      15827=      19302      15829=
U 0D48      19308      19314      19319      19333      22360=      22364=      22368=      22372=
U 0D50      19347      19351      19357      19616      19620      24759=      16014=      16017=
U 0D58      19626      19646      19663      19669      22628=      22632=      22637=      22642=
U 0D60      19675      19699      19718      16071=      19721      19725      19730      16076=
U 0D68      19734      19738      19744      19749      22774=      22780=      22786=      22792=
U 0D70      19762      19778      19792      19805      19823      16327=      19843      16330=
U 0D78      19848      19851      19855      19871      23436=      23440=      23444=      23450=

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; PCS,MCR[363,2043]      16:51 7-DEC-1977      MICRO 31(254)      STAR Microcode: PCS 01,
;                               Location / Line Number Index
; Ucode Loc'n      0      1      2      3      4      5      6      7

U 0D80      19915      19922      19927      19938      19942      19992      20002      23499=
U 0D88      20027      20030      20034      20041      20044      20077      20081      23502=
U 0D90      20084      20087      20091      20094      20097      16339=      20101      16343=
U 0D98      20111      20122      20126      20134      23523=      23529=      23535=      23541=
U 0DA0      20166      20198      20202      20206      20213      20249      20279      23595=
U 0DA8      20319      20427      20440      20460      20463      20467      20474      23599=
U 0DB0      20478      20484      20487      20491      20495      20508      20578      23684=
U 0DB8      20583      20592      20597      20616      20626      20633      20695      23687=

U 0DC0      20722      20741      20760      20768      20814      20822      20859      23817=
U 0DC8      20867      20889      20912      20991      20996      21024      21027      23821=
U 0DD0      21032      21101      21107      21110      21127      21130      16459=      16462=
U 0DD8      21146      21177      21204      23957=      21210      21225      21230      23962=
U 0DE0      21235      21271      21275      16492=      21279      21284      21290      16495=
U 0DE8      21304      21309      21317      24361=      21342      21374      21379      24365=
U 0DF0      21383      21448      21452      16513=      21457      21471      21518      16516=
U 0DF8      21522      21525      21530      21535      21540      21545      16667=      16670=

U 0E00      21549      21554      21559      21563      16682=      16687=      16690=      16694=
U 0E08      21568      21572      21576      21580      21585      16749=      21600      16752=
U 0E10      21605      21650      21653      21657      21723      16819=      21729      16822=
U 0E18      21734      21737      16874=      16878=      21742      21781      16880=      16884=
U 0E20      21797      21812      21834      16958=      16909=      16912=      16914=      16960=
U 0E28      21838      21843      16922=      16924=      21847      21869      16926=      16929=
U 0E30      21885      21890      21895      21899      21903      21907      16950=      16953=
U 0E38      21910      21914      17001=      17005=      21917      21923      17007=      17011=

U 0E40      21927      21931      22049      17074=      17028=      17031=      17034=      17076=
U 0E48      22083      22144      17039=      17041=      22202      22232      17043=      17046=
U 0E50      22236      22241      22280      22284      22288      22317      17066=      17069=
U 0E58      22378      17112=      22382      17117=      22387      17119=      22408      17121=
U 0E60      22412      22415      22420      22428      22478      17127=      22482      17130=
U 0E68      22512      22518      22534      17159=      22538      22542      22557      17162=
U 0E70      22677      22840      22845      22850      22856      22861      17193=      17195=
U 0E78      22869      22875      23013      23050      23054      23059      17202=      17205=

U 0E80      23064      23086      17211=      17214=      23091      23120      17217=      17220=
U 0E88      23144      17254=      23149      17258=      23154      17260=      23173      17262=
U 0E90      23176      23179      23184      23198      23209      17269=      23215      17272=
U 0E98      23236      23243      23248      23284      23290      23305      17491=      17493=
U 0EA0      23311      23328      23429      23455      17771=      17774=      17779=      17782=
U 0EA8      23459      23465      17862=      17865=      23479      23506      17869=      17872=
U 0EB0      23511      23516      23605      17876=      23610      23614      23619      17879=
U 0EB8      23634      23637      23641      23645      23648      18044=      23651      18048=

U 0EC0      23654      23657      23660      23664      18082=      18086=      18090=      18093=
U 0EC8      23668      23692      23707      23711      23714      18103=      23718      18107=
U 0ED0      23772      23776      23780      23784      23789      23812      18134=      18138=
U 0ED8      23827      23864      23967      18272=      23971      23975      23990      18275=
U 0EE0      24035      24073      24076      18310=      24081      24097      24100      18315=
U 0EE8      24104      24137      24140      24150      18542=      18546=      18551=      18555=
U 0EF0      24155      24161      24166      24170      24176      24182      19631=      19637=
U 0EF8      24186      24189      24193      24198      24202      24205      19768=      19772=

```


; PCS,MCR[363,2043]		16:51 7-DEC-1977			MICRO 31(254)		STAR Microcode: PCS 01,	
; Ucode Loc'n		0	1	2	3	Location / Line	Number	Index
						4	5	6
								7
U 0F00	24209	24213	24218	24223	24227	19783=	24255	19786=
U 0F08	24259	24262	24307	24311	20658=	20663=	20668=	20673=
U 0F10	24336	24340	24345	24370	20678=	20682=	20687=	20692=
U 0F18	24373	24376	24393	24398	20701=	20706=	20711=	20716=
U 0F20	24503	24508	24541	24544	24546	24562	20901=	20906=
U 0F28	24571	24575	24579	24623	24626	24642	20915=	20919=
U 0F30	24645	24661	24664	24720	20942=	24723	20946=	20951=
U 0F38				20957=				20964=
U 0F40				20968=				20976=
U 0F48					21000=		21004=	21009=
U 0F50				21014=				21021=
U 0F58				21036=				21043=
U 0F60						21055=		21059=
U 0F68						21062=		21067=
U 0F70							21081=	21086=
U 0F78				21092=				21097=
U 0F80	24766=	9738=	9743=		21133=		21137=	21141=
U 0F88						21263=		21266=
U 0F90					21346=	21350=	21353=	21357=
U 0F98							21463=	21467=
U 0FA0				23074=				23080=
U 0FA8				23224=				23231=
U 0FB0							23272=	23277=
U 0FB8						23297=		23301=
U 0FC0				23626=				23630=
U 0FC8						24087=		24091=
U 0FD0						24109=		24113=
U 0FD8				24476=				24480=
U 0FE0					24515=	24520=	24525=	
U 0FE8	24552=				24554=	24557=	24559=	
U 0FF0					24585=	24591=	24597=	

No errors detected
 End of microcode assembly
 717 pages of listing
 Used 755.10 seconds, 166 pages of core
 Symbol table: 50P
 Text strings: 18P
 Loc'n assignment: 37P
 Cross reference: 55P

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